Road Paving Material.*

BY JOHN T. CAMPBELL.

When we consider the great importance of good roads, and the many things that can be made available for paving them, we are almost struck dumb with wonder at the meagre use that is made of the fair to good material so lavishly furnished us by nature. So many people prefer to trudge along the steep, winding and muddy road over which they have once successfully travelled, that it is too often much easier for those of broader conception and greater enterprise to follow the roads of their stupid neighbors, than to make the effort and endure the vexation of leading them into better paths. Mankind in the mass progress and move forward much like the waters, crowding and jostling each other, moving only because those who are ahead are trying to keep out of the way of those who are following, and those who are following are trying to keep up with those who are ahead. Thus moving, they wander, like the running water, along the most roundabout courses, making their channels more crooked by erosion, until two bends are worn into each other, making a "cut off," and by pure stupid luck, find a shorter road while apparently trying to make a longer one.

How often have we labored and worried, both our teams and ourselves, along a muddy road, when near by, and parallel with it, a clever stream had piled up gravel in tantalizing heaps.

Coal slack, coal ashes and coal cinders make fair to good roads, yet in many parts of the coal belt of the State, the people are pulling through the mud in plain sight of heaps of that material sufficient to pave all the roads in their neighborhood, and are heard to lament the condition of the roads and the scarcity of gravel.

The best piece of road in Parke county is a section two miles long going west from Rockville, which was the first we built under the present gravel road law. Owing to the supposed impossibility of getting gravel, I, as the engineer making the survey and estimate, and afterwards superintending the construction, used coal slack for the under two-thirds of the paving material, which we obtained from the Sand creek coal mines, two and one-half miles north-east of Rockville, and covered this with the upper third of the best gravel we could get. Last winter this piece of road was the only one that was not cut into slush by the travel during the frequent freezings and thawings. The west end of this road was built of excellent gravel, and having much less travel than the east end before described, went into slush, and had to be re-graveled in the spring. I have forgotten the real cost of the coal slack, but remember that it was nearly twice as cheap as the gravel which had to be hauled less than half the distance. The coal company donated the slack, and the railroad gave favorable rates per car. The teams could haul a large wagon bed heaping full, being two and a half to three times the bulk a common gravel bed would contain. In this the cheapness mainly consisted.

But, my brethren, it was distressing to listen to the objections of the croakers at the time it was being built.

Charcoal will make a fair paving material. I do not claim that it is equal to *good* gravel, but is is much better than poor gravel. Timber is often plentiful where good gravel, or any kind, is scarce. In large quantities, it can be made and sold from the pit at three to three and a quarter cents per bushel. Five to seven yards can be hauled at a load. This almost offsets the cost of cutting and burning. It absorbs and rapidly evaporates water and moisture. It should be covered with a thin coat of good gravel, to hold it down, from blowing and washing away, and from taking fire.

My experiments have been limited to short pieces or spaces, and at my own expense, for I could never get the Commissioners to risk it, so great at the time was the storm raised about the use of coal slack, my tests of which were very successful.

A bushel of charcoal, when well packed, is equal to 1½ cubic feet. To build one mile of road, 1 foot deep and 12 feet wide, would require about 48,800 bushels of compact charcoal, which at three cents per bushel at the pit would cost about fourteen hundred and seventy ($1,470) dollars. The average haul in Parke county would not exceed one mile. At three dollars per day for teams, it can be hauled one mile at twelve cents per cubic yard, including loading, or two hundred and eighty-one ($281) dollars per mile for 1 foot deep by 12 feet wide. The breeze covering the pits is a good road paving material, and might be used instead of gravel to cover and hold down the charcoal.

A cheaper, and quite good road can be made 9 inches deep by 10 feet wide of charcoal covered 3 inches deep with gravel.

One merit charcoal has, is that when it is ground into dust, it still maintains compactness. Another is, that it will take four to five times more mud before it will become slushy, than will gravel.

In sandy districts, which afflict the traveler quite as bad as mud (except in relative cleanliness), I have very lately found out that common straw is an andidote for that heavy, miry, dragging of vehicles, which is as tiresome to the rider (out of sympathy) as to the team. Four inches of loose straw spread on a sandy road, will in a few days travel grind into sand, and become as firm and hard as a dry clay road. This may be old knowledge, but it is new to me, and I think is generally unknown to road supervisors, for I never saw it put on the sandy roads as a remedy. I first noticed it last summer, where a woman had emptied a straw bedtick on one of the worst sand roads I ever saw. The straw was worn out for bed purposes, but was just right for road purposes, as the finer it is broken up the better. Since that time I have observed every bunch of straw that happened to be dropped on such roads, and have gone to some personal trouble to put it there myself and observe the effects, which have in every case been as before described. Straw has been dropping on roads for hundreds of years, and it may be that more observing people than I, have been aware of its usefulness, but, if so, why is it not used?

This suggests that it might be used to advantage on new gravel roads, when the gravel is much mixed with sand and packs slow. It would give instant relief, and would not at all hurt the quality of the gravel.

*Read before the Association of Surveyors and Civil Engineers, Indianapolis, January 21, 1886.

AN ETHNOGRAPHICAL MAP OF ASIA.—An ethnographical map of Asia is in preparation, and will be, when completed, the most complete and accurate production of the kind in existence. The map is being prepared by Herr Vinzenz von Haardt, the cartographer to Hölzel's Geographical Institute, Vienna, who has been collecting his material for years. He has taken his data from the most authoritative scources, and under six great families has brought together 136 different types or stocks. These will be exhibited on the map by means of twenty-six different tints and hatchings, thus presenting clearly to the eye a complete picture of the ethnographical condition of Asia.

Tenacity of Nails.

The weight in pounds of a thousand of the flooring brads commonly used in carpentry may be roughly computed by taking twice the square of their length in inches. The nails or spikes used for fastening planks to beams are usually of a length equal to from twice to twice and a half the thickness of the planks. The following are the results, as stated by Tredgold, of experiments by Bevan on the force required to draw nails of different sizes out of dry Christiana deal into which they had been driven to different depths across the grain:

Kind of Nails.	Length. Inches.	No. to the pound.	Inches driven	Force to draw. Pounds.
Sprigs	0.44	4,560	0.4	22
"	0.53	3,200	0.44	37
Threepenny brads.	1.25	618	0.50	58
Cast-iron nails	1.00	380	0.50	72
Fivepenny nails	2.00	139	1.50	3.0
Sixpenny nails	2.50	73	1.00	187
"	2.50	73	1.50	327
"	2.50	73	2.00	530

So far as these results can be expressed by a general law, they seem to indicate that the force required to draw a nail driven across the grain of a given sort of wood varies nearly as the cube of the square root of the depth to which it is driven; and that it increases with the diameter of the nail, but in a manner which has not yet been expressed by a mathematical law. The following are the results of Bevan's experiments on the force required to draw a "sixpenny nail" of 73 to the pound, which had been driven one inch into different sorts of timber:

Deal across the grain	187 pounds.
Oak	507 "
Elm	327 "
Beech	667 "
Green sycamore	312 "
Deal, endwise	87 "
Elm	257 "

The following were the forces required to draw asunder a pair of planks joined by two nails of 73 to the pound:

Deal, ¾ inch thick	712 pounds.
Oak, 1 inch thick	1,0.9 "
Ash, 1 inch thick	1,420 "

—*W. J. M. Rankine.*

NEW YORK BRICKS.—The forty-five brickyards at Haverstraw, N. Y., on the Hudson River, 32 miles above New York city, the largest brick-making center in the country, with a capacity for making 340,000,000 bricks annually, turned out 300,000,000 in 1885, against a like number in 1884. About 2,000 men are employed besides 300 in the river carrying trade, which keeps 44 barges and 50 small vessels busy. Haverstraw bricks are of ordinary grade, but bring 25 to 50 cents per 1,000 more than other bricks of like quality, owing to the excellent sand and clay used. They brought an average of $6 per 1,000 in New York last season after paying $1 river freight and $1 to a $1,25 per 1.000 royalty to the owners of the land where the yards are located. The works use in a season 42,000 cords of wood at $5 per cord for heating kilns; 12,000 tons of coal-dust at $2 per ton; and 4,000 tons of coal at $4.25 per ton; a total cost for fuel of $251,000. The total royalties were, as above, say $337,000, and wages (averaging $2.25 per day), say (six months), about $776,000. Two hundred patent brick-pressing machines, costing $1,000 each are employed. The total gross receipts last year are given at $1,800,000. This particular industry began fifty years ago. At that time $3 per 1,000 was a fair price. Quotations have been as high as $9.—*Scientific American,*

Municipal Engineering; Paper No. 2.*

PROVIDENCE, RHODE ISLAND.

(*Continued from Page 241*).

Water Supply.

The water supply of Providence is taken from a river in a neighboring town and pumped into a reservoir located upon a hill near by. From this reservoir it flows by gravity into the city, directly supplying another reservoir within the city limits and also that portion of the city which is of sufficiently low elevation to be served by gravitation; supplementary pumping machinery is used. The consumption during the year 1885, including waste and leakage, was 4,730,556 gallons.

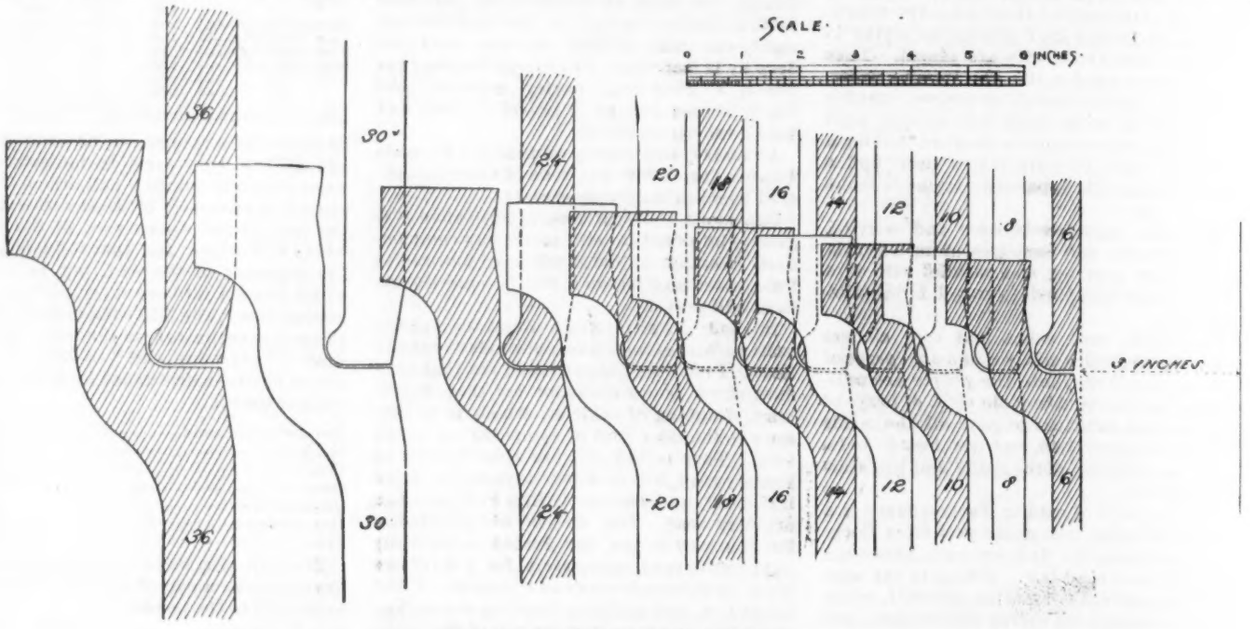

Plate 1.—Standard Pipe Sections.

Water Distribution.

Water Pipe.—The specifications for standard cast-iron pipe, as applied in Providence, provide that the metal used shall be made without any admixture of cinder iron or other inferior metal; that it shall be of such a character as to make castings tough, strong and uniform in texture, free from uncombined carbon, and not too soft nor so hard but that it will satisfactorily bear drilling and chipping or cutting. The metal must be remelted in a cupola or air furnace and specimen castings, of a size and form suitable for a testing-machine, must be made from each heat, if desired by the City Engineer, and these specimens must bear a tensile strain of 16,000 pounds to the square inch.

All pipes must be cast vertically with the hub end down; and the moulding sand or loam must be of a character which will leave the surface in a good condition to receive the coal-tar varnish. The castings must be whole, free from scoria, sand-holes, etc.; not plugged or filled; be truly cylindrical in the bore straight in the axis and externally and internally of the full specified dimensions, with the outer and inner surfaces concentric so that the thickness of shell is uniform.

All castings after being perfectly cleaned must be subjected to a thorough hammer test and be dipped before any rust appears; no acid or other liquid shall be used in cleaning the pipe.

The coating inside and out with coal-pitch varnish is according to Dr. Smith's process; the casting must be heated to a temperature of 300° Fahr. immediately before dipping and must remain in the bath at least forty-five minutes.

After being dipped, the castings when dry and perfectly cool shall be subjected to a hydrostatic pressure of 300 pounds per square inch, and if so ordered by the Engineer, they shall also be subjected to a careful hammer test under this pressure.

Every pipe and casting must have cast upon it the initials of the makers' name and the year in which it is cast; and have in addition cast upon it the running number of the casting of the same size and the class letter. These letters, etc., must be on the outside, be not less than 2 inches long and ¼-inch in relief. The weight of each pipe and casting must be conspicuously painted upon it with white lead paint.

Following is a table of weights and dimensions of water pipe as adopted by the Providence department:—

Table of Weights and Dimensions of Water Pipe. Length over all, 12 feet.

Nominal Diameter. Inches.	Class.	Thickness of metal. Inches.	Standard weight. Pounds.	Greatest proposed head in feet.
6	B	1-2	402	180
8	A	1-2	533	100
8	B	9-16	590	180
10	A	17-32	700	100
10	B	19-32	772	180
12	A	9-16	885	100
12	B	21-32	1016	180
14	A	19-32	1082	100
14	B	11-16	1236	180
16	A	21-32	1375	100
16	B	3-4	1533	180
18	A	11-16	1594	100
18	B	25-32	1789	180
20	A	23-32	1852	100
20	B	27-32	2143	180
24	A	13-16	2502	100
24	B	15-16	2850	180
30	a	13-16	3155	60
30	A	29-32	3484	100
30	b	1	3809	140
30	B	1 1-16	4026	180
36	a	7-8	4101	60
36	A	1	4627	100
36	b	1 1-8	5148	140
36	B	1 1-4	5667	180

Plate No. 1 shows the form of bells and spigots used on ordinary pipe.

The lead used for joints is according to the following table:

Diameter in inches	6	8	10	12	16	20	24	30	36
Lead per joint in lbs.	4.73	6.53	8.56	10.84	15.85	21.14	28.33	37.32	50.45
Width of lead in inches	1⅛	1⅛	1⅛	1⅛	1⅛	1⅛	2	2¼	3

Form of House Connection.—House connections are generally made as shown on Plate 2, when the main pipe is on the same side of the street as the building. When it is on the opposite side the service pipe is laid across the street and carried into the building in the same manner. A tap is screwed into the main, and by the aid of a Jones tapping machine (see Plate No. 7 "Boston" article pp. 102 *ante*, the service pipe is connected. The service pipe is laid about 4.67 feet deep under the sidewalk into the building. A stop is located just inside of the curbstone by which the water is shut off or let on with a long wrench from the sidewalk, a box being set over the stop for this purpose. The service pipes are generally cut at the shop, a little longer between the tap and stop than the surface measurement calls for in order to allow for settling and a possible increase of length that may be required when it is being laid. This additional length when not required is taken up in the form of a "goose-neck" near the main pipe. Main pipes larger than 20 inches in diameter are not tapped for domestic supply, and in streets where 24 and 30-inch mains are laid, riders or 6-inch pipes are also laid for this purpose. The total number of services in use, December 31, 1885, was 11,989, 55 per cent. of which are metered.

Material for Service Pipes.—The city lays lead pipe from the main pipe in the street to a point 1 foot inside the stop in the sidewalk. (See Plate 2.) At this point a plumber connects and continues the service into the building, with the kind of pipe that the owner of the premises may desire, provided that the strength, etc., conforms to the regulations of the Board of Public Works. The pipe generally used is lead, although iron and brass are used to some extent, and in some instances tin lined lead. In the latter case if a building is to be plumbed with tin lined lead pipe, and a special request is made, the city will lay a

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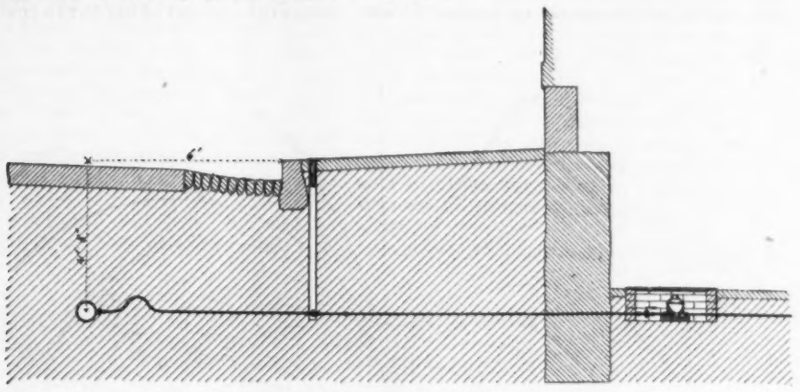
service pipe of the same material in the street from the main pipe to the sidewalk. The size of the service pipes from the main pipe to the sidewalk are determined by the City Engineer's Department, in accordance with the supply required. The strength of pipe used in plumbing buildings, their protection against freezing, the kind of faucets and other



SERVICE PIPE CONNECTION ETC.

Plate 2.

fixtures, and the general arrangement of the work in reference to its security and safety are to be subject to the approval of the proper officer representing the Board of Public Works:

Be very careful to avoid mistakes at all times, but when you do make a mistake (as you surely will), own it like a man, and hasten to make all proper correction.

When doing field work in the presence of

Advice to Young Surveyors.

BY D. B. HOSBROOK, COUNTY SURVEYOR OF MARION CO.

These brief remarks are designed exclusively for beginners in the business; believing, as I do, that old practitioners know enough to take care of themselves or quit the business.

fence for a guide, be careful to unclamp your needle before taking your bearings.

Do not hastily condemn your instrument on a cloudy day, because it does not point—as you think—north. You are more liable to get bewildered than your instrument.

Be sure to have a flagman fifty pounds heavier than yourself. If the ice bears him you can safely venture.

If, in summer, you find a swamp beyond your depth, face about and wade back. That would be prudence, and not cowardice.

If you mire down in quicksand, or any other treacherous substance, and find it utterly impossible to extricate yourself, call for help. Almost any patriotic citizen is willing, under such circumstances, to assist the profession by giving science a boost.

When you are given great credit for accidently striking a corner, pocket it quietly (the credit, not the corner) for you will surely get censure for missing one when you are not in the least to blame. This is called equation.

When, in winter, your fingers become so numb that you cannot turn the clamp screw, use your teeth.

When you fail to procure a support by your profession, chop wood night and morning.

South Australian Exploration.

Perhaps there are no men who have rendered more service to progress and to civilization than those who have devoted their energies and their skill to the exploration of un-

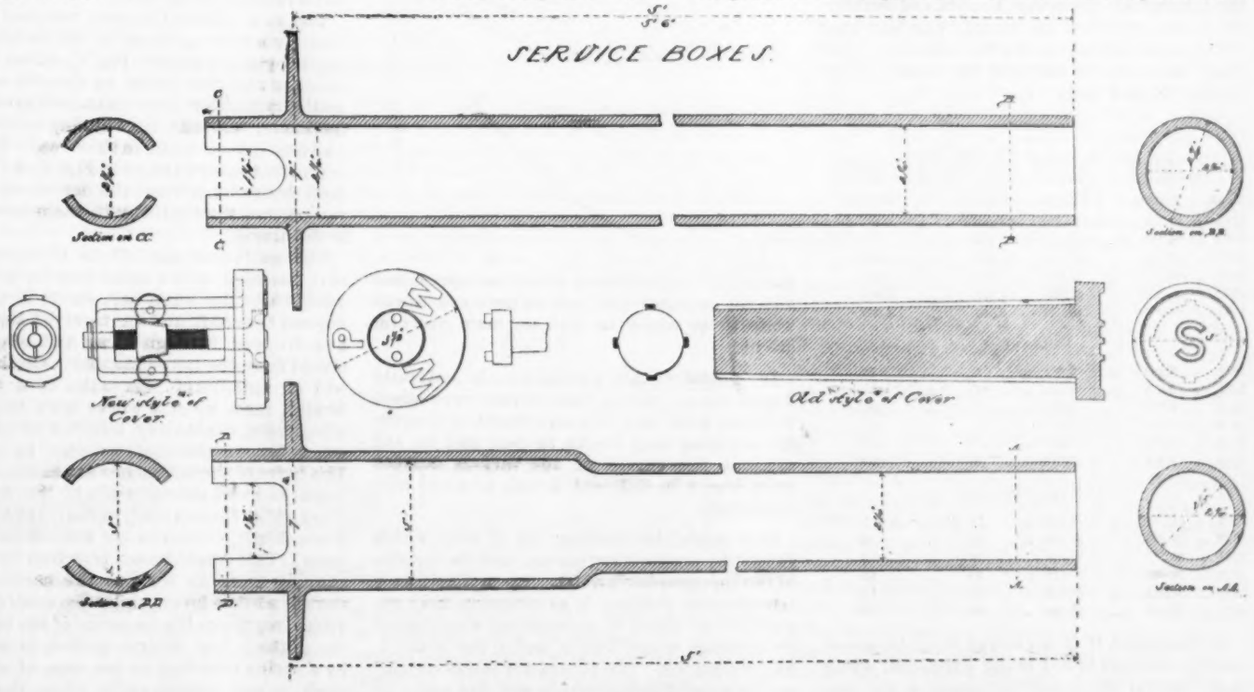


Plate 3.—Service Boxes.

Table of weights and dimensions of lead service pipes:—

Interior Diameter.	Weight per foot.
1-2 inch.	3 pounds.
5-8 inch.	3 pounds, 8 oz.
3-4 inch.	4 pounds, 12 oz.
1 1-4 inch.	9 pounds.
1 inch.	6 pounds.

Service Pipe Boxes.—The service boxes used are made of cast-iron, (see Plate 3.) The style of cover now used is so arranged that by the aid of a small key it can be firmly locked in position.

(TO BE CONTINUED.)

an old practitioner, be calm, cool and careful; do not try to convince him that you are an adept, by flippantly slinging your notes down on paper, without any clear idea of whether they are correct or not.

This might serve to add to his amusement as a spectator, but it would not add to his desire to employ you as an assistant.

Do not fear that he will think you slow and awkward; he has traveled the same road, and still feels the pressing necessity of diligent care, in order to avoid errors. Be diligent, careful, slow and sure, and you will get there by and by.

When in the timber, or in the absence of a

known continents. In the last "Echoes" from South Australia brief mention was made of the work of Mr. Charles Winnecke, in Central Australia. His record, however, is of such interest that it will justify further reference. It appears that he has made a plan of the country through which he passed in following the overland telegraph wire from Port Augustus to the Queensland boundary, which shows that the distance from Tennant's Creek, and thence eastwards over the rivers Buchanan, Rankine, James, Herbert, and Milne is 1,626 miles. The country continually rises from Port Augusta till Burt Plain on the MacDonnell ranges—a distance of 1,000 miles—is reached, after which it falls gradually to the

boundary. Mr. Winnecke has included in his plan every camping-place along the telegraph line. He again asserts that Lake Eyre is a considerable depth below sea level—a statement he made in 1877, but which has been disputed. The highest point attained on the route was the Burt Plains in the MacDonnell ranges—2,532 feet above sea level—but the ranges themselves are several thousand feet higher. The telegraph station of Central Australia—Alice Springs—is 2,000 feet above sea level, Strangeways Springs being 188 feet, Peake 75 feet, Charlotte Waters 481 feet, Barrow Creek 1,724 feet, and Tennant's Creek 1,075 feet. The Finke river at its southern termination is 930 feet. This river is described as the largest and most important in Central Australia, and a good supply of water is always obtainable from it. Mr. Lindsay, it may be noted, is re-exploring the southern part of the Finke. The base of Central Mount Stuart, which is supposed to be situated exactly in the center of Australia, is 1,725 feet above the level of the sea, but the hill is considerably higher. Its exact height has not yet been ascertained. The plan is an exceedingly valuable one.—*Colonies and India.*

Metal Railway Sleepers.

M. Bricka, the French State Railway engineer, who has sent by M. Raynal to study the question of metal sleepers on railways in Holland, England, Germany, Austria and Switzerland, has published his report. The following table shows the extent to which metal sleepers have been used in three of the countries between 1878 and 1883:

GERMANY.

Year	Length of railways. Kilom.	On wood sleepers. Kilom.	On longitudinal metal sleepers. Kilom.	On metal. cross sleepers. Kilom.
1878	53,780	51,627	1,455	283
1879	56,298	52,615	2,539	789
1880	57,295	52,257	3,194	1,336
1881	58,164	51,836	3,806	2,000
1882	59,526	51,756	4,200	3,073
1883	69,803	51,627	4,666	4,009

HOLLAND.

1878	2,848	2,667	1	80
1879	2,620	2,483	17	121
1880	2,772	2,564	17	191
1881	2,869	2,625	17	227
1882	3,101	2,824	17	260
1883	3,333	3,026	17	290

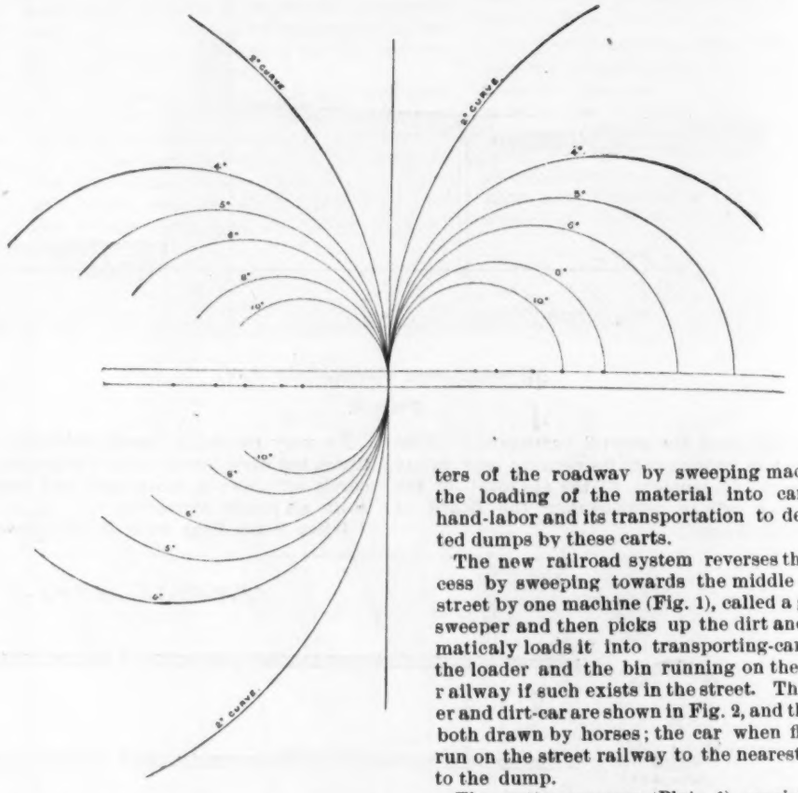
AUSTRIA-HUNGARY.

1878	24,158	24,139	19	1
1879	24,333	24,309	21	4
1880	24,577	24,547	26	4
1881	24,760	24,717	30	13
1882	25,581	25,519	44	18
1883	26,650	26,556	68	26

In Germany, it is apparant that the use of wooden sleepers is not being extended, while that of metal sleepers is increasing at the rate of 1,000 kilos, annually, and at the end of 1883, there was 8,675 kilos. The employment of cross sleepers also finds more favor than that of longitudinal sleepers. In 1883, Holland had 307 kilos. of metal sleepers, but it is certain that during the last two years, the extension has been at a considerably greater rate. Switzerland is the country in which the proportion of metal sleepers is largest. In 1884, there would be 200 kilos, last year 300. In Algeria, 100 kilos. of metal sleepers have been laid down. The French Minister of Public Works is to receive, till the 17th inst., tenders for the supply for the State Railways of 17,300 mild steel sleepers of various sections, and 8,200 mild steel sleepers of the same section, delivered at la Tuye, near Chartres, in three months.—*Iron and Coal Trade Review.*

A Handy Curve Protractor.

A correspondent sends us a communication inclosing the curve-protractor illustrated herewith and testifies to the fact that he has found it exceedingly useful and as worthy of publication for the benefit of locating engineers who are not as yet familiar with it. Unfortunately, in the process of having the cut



made, the original letter of our correspondent and his name are lost, and we must ask him to write to us again so that we may give him credit.

In practice this protractor is carefully drawn out on tracing liner to any convenient mapping scale and with any length of tangent the engineer may see fit to use; and in the original the curves of the various degrees were drawn in different colors to avoid any confusion.

It is useful in locating on a map which shows the preliminary survey and the results of the topographer's notes. By laying it over the map and shifting it as occasion may require, it can easily be ascertained what degree of curvature would best fit under the controlling conditions. The protractor shows continuous curves of one direction and the same or different degrees of curvature and with more or less tangent between, compound and reverse curves. In fitting in a line on the map we should say it was much more convenient in application than the ordinary rubber curves, and is so simple that it can be made to fit any scale to be used.

Every acre of pine land in Michigan has been purchased from the Government. It is stated that Michigan men have purchased nearly a million and a half of acres of the long leaved pine lands of Louisiana and Mississippi lately at a cost of $1.25 per acre—a total of something like $1,800,000 having been paid for them. It is believed that the standing timber aggregates 15,000,000,000 feet of lumber.

Cleaning Cities by Railroad.

A New Self-Loading Street Car.

The illustrations given herewith, show a novel form of self-loading street sweeper by cars, patented in February last by Mr. A. J. Reynolds of Chicago, Ill.

The ordinary system of cleaning streets requires the removal of the dirt to the two gutters of the roadway by sweeping machines, the loading of the material into carts by hand-labor and its transportation to designated dumps by these carts.

The new railroad system reverses this process by sweeping towards the middle of the street by one machine (Fig. 1), called a gutter-sweeper and then picks up the dirt and automaticaly loads it into transporting-cars, both the loader and the bin running on the street railway if such exists in the street. The loader and dirt-car are shown in Fig. 2, and they are both drawn by horses; the car when filled is run on the street railway to the nearest point to the dump.

The gutter-sweeper (Plate 1) consists of a cart carriage with a small box for a driver's seat; while the shaft-bar, which is extended beyond the shaft and in front of the wheel, has dropped through it an axle slightly inclined from the perpendicular. On the lower end or spindle of this axle, is a circular-broom, made up of a wheel with the dished side down, containing bunches of rattan or other broom material between the spokes. The butts of these bunches are clamped to an inside rim and the outer rim of the wheel, beyond which they extend, radially presses them down firmly to their work with an unvarying force. This wheel broom is driven by a chain running from its hub to the cart-wheel as shown, while a lever, under the control of the driver, regulates the pressure of the broom on the gutter. Any lateral motion is governed by a spring attached to the side of the cart-shaft, which spring yields when the broom presses against the curb. The broom being tilted, its outer splints reach into the angle made by the curb with the street, and cleans this angle thoroughly throwing all material out into the street. The inventor claims that one machine will sweep as fast as a horse can walk and in one day do as much gutter cleaning as about forty laborers.

By placing two or more additional brooms behind the gutter-broom and diagonally across the cart, the machine is transformed into a gutter and surface sweeper combined, each broom acting independently and following all irregularities of the street surface.

Plate 2 shows the self-loading dumping car, which is intended to run on the street railroad and to pick up the dirt after it is transferred from both gutters to the center of the

street, and store it for the time being in the bin shown in the rear of the sweeper or loader, saving a large amount of time and horse power, as it runs on the car tracks, sweeping and loading.

This machine and its working may be described as follows: In Fig. 2 is shown a side elevation with the casing removed from one side of the brush. The motive power is derived from the forward truck of the dump-car and by a chain-belt acting upon an axle rotates the broom. The casing follows closely the contour of the broom, reaching nearly to the ground, as shown. The rapid motion of this broom practically acts as a suction fan in addition to its sweeping effect, and all material over which it runs is thus thrown or sucked up and transferred to the bin, which, in this case, forms part of the machine. A

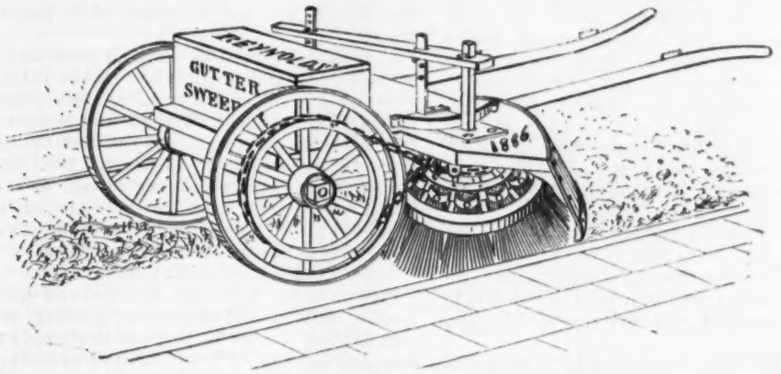


Plate 1.—Gutter Sweeper.

trailing apron at the front end of the drum (7, Fig. 2), facilitates the transfer of the dust up the front wall of the drum and a supplemental fan (9, Fig. 2), may be used to assist in throwing the dust into the bin. As will be seen from the plans, the bottom of the bin is V-shaped, so that the car can be readily emptied from a track by opening the side doors shown in both views.

In another form of this machine the loader

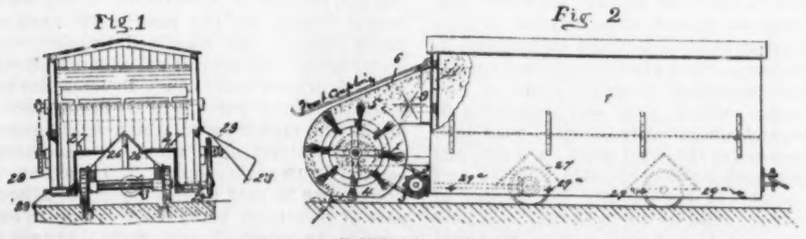


Plate 2.—Self-loading Sweeper.

is detached from the bin and the dust is conveyed to the latter, or even through it to a second or third car in a train, by a suitable arrangements of conveyor-belts.

The advantages claimed for this radical departure from ancient methods in street cleaning are: That, first of all, the gutters can be more thoroughly cleaned and at less cost than by hand labor; the difference in cost being represented by about $3.50 per day for the gutter sweeper, as compared with what would be paid thirty or forty men (say, $35 to $50 in all) for practically doing the same work. Then, outside of the gutters the street railways present the most trouble, as the ordinary sweeper passes over them diagonally and leaves mud and ice in the grooves of the track; the loading car, on the other hand, running, as it does, on the street railway, cleans the track and its grooves. The loader sweeps 7 feet wide and thus extends out 15 inches beyond each rail and takes in almost one-fourth the width of an ordinary street or about all in such a street that the gutter sweeper would leave uncleaned.

As to expense, it is estimated that the loading car can be run for $1 per hour, or for 2½ miles, and at the same cost as shovelling by hand into carts over the street length. But in this case the dirt can be conveyed to or very near a dump on the street railway and at street car speed. As the work is to be done at night when but few if any cars are running, arrangements can be made with the company for hauling the cars. As these cars will hold from ten to fifteen cubic yards of dust each, $1 per mile paid for transportation would make the cost from about seven to fifteen cents per yard, while it now costs from thirteen to twenty-five cents for this item alone.

On streets where there are no rails, a special form of this machine, with the attached loader referred to, will work quite as well saving that it cannot travel or load quite as fast; the car loaded by this machine will, however, run on the street tracks, and can be by them quickly taken to the dump.

From estimates made by the Superintendent of Streets of New York, the cost of street cleaning may be stated as follows;

The present one-horse sweeper sweeps about 2½ miles of street per day, and travels fifteen to eighteen miles in making six trips. It sweeps 4 feet wide, or 34 feet by half mile in one hour. The cost per hour is rated at forty cents; per day at $2.50. One man in one day scrapes gutters and puts the dirt on piles over half mile of street for $1.25. One horse and a driver for sweeper costs $3.50 per day. One cart and horse and driver cost $3.50 per day. The hours of labor daily are eight to ten hours. Distance to dump, half mile to four miles, average, two miles. Average loads daily by carts, ten loads; average travel daily by carts, fifteen to twenty miles. Cost of present one-horse sweeping machine, $350 and cost of a horse and harness for same, $300 for each of two horses, or $650 for horses and harness.

In contrast to the above figures, it is claimed that two miles of gutters can be cleaned by the gutter sweeper for thirty cents supposing the machine to run only two miles per hour; but as it should travel at least three miles in that time the expense would thus be reduced to twenty cents per mile of street or two miles of gutters. With ordinary sweepers it now costs $1.50 to sweep one mile of a street 24 feet wide. To load dust from one mile of street surface now costs from sixty-five cents to $1, or one man's labor for from one-half to three-quarters of a day according to quantity.

The loading cars will do the same work in half an hour at an expense of from forty to fifty cents, and the labor of gathering the dirt into piles is entirely dispensed with. The hauling to the dump now costs from 25 to 50 cents per cart load (1¼ cubic yards) per mile or twelve to twenty-five per cubic yard per mile. The use of the dump car, holding from ten to fifteen cubic yards and paying $1 per car per mile for transportation, will reduce the cost to from five to ten cents per yard per mile. The general summation of all these savings amounts to about 50 per cent. over the present cost of work, or represents that much saved.

Gravel Roads.*

BY CHAS. C. BROWN, C. E., TERRE HAUTE, IND.

Argument for the desirability, nay necessity, of gravel roads, may not be deemed necessary, but I have gathered together a few points which may be of interest in this connection. Prof. Sanborn, of Columbia, Mo., has made a few tests of the amount of force exerted in drawing loads over good and bad roads, with and without grades, with the following results: The load drawn was 3,695 pounds. On a moist dirt road the force exerted in drawing the load on a level was 487 pounds, or it was 17.6 of the whole load. On a gravel road the force exerted on a level was 118 pounds, or 131.3 of the whole load, or less than one-fourth as much. That is to say, a team can haul four times as large a load on a gravel road as on a moist dirt road, with the same amount of force exerted. The meaning of this in effect is that, given a certain tonnage to move, one-fourth as many teams are required to move it on a gravel road as on a dirt road. None of these calculations take any account of the difference in effect upon the horses on account of the difference in conditions, but simply of the number of pounds of force exerted to pull the load. It will be noticed also that this, although on a moist dirt road, is not on a muddy road or one worn into ruts, chuck holes, etc., and it will be borne in mind that while much rain will make hauling on a gravel road somewhat more difficult, it will make but little difference if the road is properly constructed and drained, while it will make a dirt road, especially if in a clayey soil and underdrained, absolutely impassable even with a light buggy and team. We can then readily measure the value of a gravel road in dollars and cents. Assuming, with Rankine, that the force that can be most economically exerted by a horse on a walk at steady work, is 120 pounds, two horses on a level gravel road can haul a load of 7,512 pounds, (240x31.3), while on a dirt road, such as used in experiments, the same team could haul but 1,824 pounds (240x7.6). This gross amount might probably be increased fifty to seventy-five per cent. on a dirt road in good condition, or even to equal a gravel road at certain seasons of the year and in certain places on the road, while again it may be decreased to zero when the road is in its worst condition, so that this may be taken as a fair average for the common dirt road. These amounts may also of course be somewhat exceeded for short pulls, with short allowance of time for rest. But all the figures given are intended to be

*Read at Annual Meeting of the Association of County Surveyors and Civil Engineers of Indiana, Jan. 20, 1885.

for the average road and team with steady work; not too easy, so as not to give the team as much as it can do, nor too hard, so as to wear out the team before its time. Not stopping to distinguish between gross load and net load, the saving on the gravel road will then be in round numbers three teams for every four tons hauled, or supposing four tons were to be hauled over the road per day, three teams per day would be saved. Three teams at the low price of two dollars per day would save six dollars per day, which is the interest at six per cent. on about $36,000, a sufficient amount to construct and maintain from five to eight miles of first class gravel road. So that the users of every stretch of five to eight miles over which an average of only four tons a day is hauled, can afford to gravel that road, as our calculation goes, and have the profit resulting from less wear and tear of teams and wagons, and from being able to get produce to market at any time desired. Teams saved on tonnage, in excess of four tons per day, will be so much clear gain in addition. How many roads are there running through each of our counties that have an average of four tons per day or more hauled over them? A very large percentage, I venture to say sixty to seventy per cent. If we were to base our calculations on net load rather than on gross load, our figures would be more favorable to gravel roads, for the tear does not bear any direct ratio to the gross load. An additional point of advantage of the gravel road will be its reduction of gradients, a point to be mentioned further on.

Granted then that we must gravel our road when the traffic is more then four tons a day, the question is, what must be done to construct our road in the most economical and durable way? This must be answered generally by the engineer for the particular road to be built, but a general plan may be laid out, and a few suggestions made, as derived from practice and observations. As a basis for my remarks I have taken an abstract of specifications made by Mr. S. J. Craig, of Auglaize county, Ohio, for what seems to be an average kind of gravel road, more because they were at hand for than any other reason. I have left the question of land drainage and benefits altogether out of the question for obvious reasons. Also the question of route, except as it is discussed incidentally with other questions, has been omitted, as well as the subjects of surveys, estimates, contracts, etc. The subject is too large to cover with one blanket.

1. *Roadway.* Twenty-five feet each side of center line, to be cleared of all obstruction in grade and in ditches, grubbed in cuts and side ditches, and bush and stumps cut off even with ground in fills.

2. *Line.* Marked by stakes twelve feet each side of center line.

3. *Road bed.* To be made on grade line of profile, twenty-four feet wide, crowning eight inches higher in center than at hip of grade. At culverts and bridges to be level, and to slope back to above form at twenty feet from bridge or culvert.

The matter of grades permissible is one to be considered in each especial case, but it would seem easy to determine the maximum grade which should be allowed on a given road. Prof. Sanborn's experiments show that it requires 310 pounds to pull a load of 3,695 pounds up a grade of one to twenty-eight, or 3.6 feet in 100, or 1 11.9 of the load; nearly three times the draft on a level, or, as before, three times as many teams will be required to haul a given tonnage up a grade of 3.6 feet in 100 as on a level. No experiment is recorded giving a comparison between haulage up grade on a gravel road and up the same grade on a dirt road, but it seems probable that the difference would be even greater than between the two roads on a level. (It may be mentioned in passing that Prof. Sanborn's experiments agree excellently with those made by other persons in the same direction). While it is true that a team can, for a short time, exert more than its average force, we could hardly expect it to exert three times that force, so that our wagon would have to be loaded somewhat less heavily on account of such a gradient, and the load would become less and less as the gradient became steeper, so that experiment can show how much less there will be with a given grade, and how much money it will be economical to spend in reducing the ascent on a longer stretch of road. The maximum gradient adopted wherever in any way possible, has been one in thirty, or 3.3 feet in one hundred, quite long detours being sometimes made to avoid steeper graded, though these steeper grades are sometimes found for short distances, on some of our best roads. A point may come in here to complicate the question somewhat. If the greater part of the loads go in one direction, and that direction is down hill, steeper gradients will be economical, provided they are not so steep as to require exertion of excessive force in holding back.

4. *Side Slopes* in embankment, two to one from hip of grade to bottom of ditch, extending in no case less than 2 feet below grade; on fills more than 2 feet high, one and one-half to one; in excavation, and back slopes of ditches, one to one.

5. *Side Ditches.* Through cuts to be 1 foot deep and 3 feet wide, with side slopes as above; in other cases to be evenly constructed to make complete drainage to natural water ways.

Too much stress cannot be laid upon the proper drainage of a gravel road. As a great Canadian engineer and contractor says of railroads, there are three things necessary in building a gravel road; the first is to drain it, the second is to—drain it, the third—well, that is to drain it, too. Every foot of a gravel road should be supplied with sufficient drainage facilities to carry off at once all water that may come to it, and leave nothing to sink into the road bed to soften and disintegrate it. The ditches on steep grades need often special attention, especially in clayey soils, to prevent undue cutting away and deepening of ditches, and subsequently injury to road bed. The drainage of the road when on a side hill is often a matter of considerable interest, and gives plenty of opportunity for display of engineering abilities in effecting complete drainage cheaply, and with as little danger to the road bed as possible. It may be well to state the general rule that the water should be carried through from the upper side of the road to the lower as soon as possible, due consideration being given to the amount of water draining down to the road, the rapidity with which it comes, the liability of the soil to wash out, the expense of repairing damage to the road from extra flows, as against the expense of putting in cross drains, the facilities for getting rid of the water on the lower side without damage to property, etc. On long levels, especially when what slight slope there is, is from each direction into a basin, a special treatment is necessary, and it will be well sometimes to lay lines of drain tiling under the ditches on each side with sufficient capacity to carry the water (usually in small amounts in such cases) to a proper outlet. One error of scientific engineers, especially those whose experience has been with railroads, is in putting in too great lengths of road without change of gradient. The objection to such construction is obviously that water falling on the roadway, or getting on it from imperfect drainage, will run down the wheel tracks until it accumulates in sufficient quantities to wash out the roadway, when it finds or makes an opportunity to escape from this route, making necessary frequent repairs at such places. A proper reversal of gradient, or a simple reduction of gradient, so as to check the flow of water and cause it to spread over to the sides of the road would remedy the matter.

6. *Crossings* of public ditches must preserve full capacity and depth of ditch; of roads, approaches to be made 20 feet wide, with gradient of not more than one in four, graveled with ten cubic yards of gravel, spread to suit each particular case.

7. *Shrinkage* must be allowed for in embankments, the amount of allowance to be determined by the engineer on consideration of character of soil and condition when put in place.

8. *Stone Culverts* to be built of good-sized, well-shaped quarry stone, 6 to 8 inches thick, 2 feet wide, with parallel beds, laid dry, making walls 2 feet thick. Trenches for walls to be 1 foot wider than walls and not filled up till inspected and accepted. Coping for box culverts to 8 inches thick and long enough to extend 1 foot on each wall. No space in joints to exceed 1 inch, and exposed stones at ends of culverts to be squared and pitch-faced.

Wooden Culverts. Special plan for each.

Pipe Culverts. To be put in place, and protection walls completed before grading; no logs or other timber to be permitted within 1 foot, and earth to be firmly tamped under the sides; unless otherwise directed, to be laid with bottom level with side ditch, each end to be protected with a stone wall laid dry on each side, 2 feet square, beginning 6 inches below lower side of pipe, 1 inch in the clear from sides of pipe, and brick above its top; on top of walls a stone to be placed 2 feet wide, 3 feet long, 6 inches thick; walls and cap to stand flush with end of pipe; only first-class vitrified stone pipe to be used.

A point too often neglected in constructing a gravel road is the consideration of the proper size and position of the culverts. Every water course crossed by the road must have an outlet through the road bed by culvert or under bridge, and special examination should be made of each water course to determine the amount of water which is likely to come down it, and the rapidity with which it will come, and the culvert must then be made large enough to carry this water. Too much attention cannot be paid to this point, for a large part of repairs on many roads is due to culverts being too small, or to their being put in such position and with such lack of protection that they fill up and overflow. It is perhaps better to err on the side of too large culverts than too small, but sufficient study of the drainage of the road will be well repaid on the one hand by saving of repairs from washing away of road bed, and on the other by saving expense of putting in drainage facilities much too large for the work required of them. In a country like ours, where quarry stone is not plenty, vitrified pipe culverts and wooden box culverts are principally used. Pipe culverts are not expensive, and are easily put in, and a judicious use of them in carrying the drainage across the road will sometimes obviate the necessity of large culverts. We have an instance, where the road runs on the side of a steep hill, where a brick wall was put down on the upper side of the road to a depth sufficient to carry a circular brick culvert across the road on proper grade to prevent the wearing away of its bottom, to a point far enough down the hill to carry the water entirely away from the road. We have never determined whether in the original construction of the

road the necessity of this addition might not have been obviated by a proper arrangement of grades and use of small culverts, but I think it probable that it might. It is sometimes necessary to put an apron of plank or large cobble or quarry stones at the lower end of a culvert to prevent washing out of bottom, and every culvert should have sufficient extent of wing walls to preserve the integrity of the grade.

9. *Bridges.* I will say but little on this subject, only describing the following construction of superstructure, as exemplified in our neighborhood, as appearing to be economical for the smaller bridges in wood (eighteen to thirty feet span). The compression members in each truss are two inclined posts, meeting at the center of the span. A floor beam is suspended from the two trusses by two pairs of iron rods, spread some distance apart at the bottom, and is steadied by a piece spiked to the Λ and to the extended floor beam. Joists are then laid from the floor beam to the piers each way, and flooring put on the joists. With a 16-foot roadway, and a span of 18 feet, this makes the joist 8 feet long instead of a little over 16, and substitutes the floor beam for the lower chords of the trusses, as the triangular truss is usually built, and is an obvious saving. The span of the joists will be less than by the ordinary method, until this span becomes 32 feet, and the construction is economical to about that limit. This construction is not new, but I have not often seen it used. The following method of anchoring timber trestle piers for small bridges and large culverts, is found to be cheap and effective: A 3-inch plank is buried in the grade, edge up, one-third of the height of the pier above its base, some feet from it, and parallel to it. Two other 3-inch plank are halved on this at right angles, and are dove-tailed into two of the posts of the trestle. The first plank put in acts thus as an anchorage with a bearing surface against the ground of the width of the plank, and the other two planks are the ties connecting the ties with the pier. Similar anchorages are put in, when necessary, for the wing walls.

10. *Gravel.* The gravel should be put on thick enough to make, when packed, an impervious coating to the road, not to be cut through by wheels, or soaked through by water. It is often desirable to put it on in two or more layers, allowing the first layer to pack before putting on the next. The theory of McAdam, in his road-making, was that the natural soil was sufficient to carry the loads passing over it if it was kept dry, so he bent his energies to covering it with a water-proof coating of broken stone or gravel. Our ordinary pit, bank, creek, etc., gravel may be considered as mixtures in various proportions of coarse and fine gravel, sand and loam. As I understand it, coarse, pure gravel packs slowly but effectually, and makes the best road in the end, though fine gravel is not far different. Mixture of sand prevents packing in proportion to the amount put in, while mixture of loam or clay makes it pack more quickly. Fine gravel, with a small amount of loam, will make a good road quickly, but will not be so durable as pure, coarse gravel, or a mixture of pure, coarse and fine gravel. Any road, especially one covered with coarse gravel, should have constant attention, and be properly smoothed off and irregularities corrected, until it becomes thoroughly packed.

11. *Repairs.* A gravel road, well and properly built, will need but slight repairs for some years, but each five to eight miles of road should be in charge of an inspector or supervisor with responsibility for keeping the road always in thoroughly good condition. A very few days work in the year, if put in at the right time, will save many dollars of repairs, if they are left to be done in one big job at the end of one year, or of three or five years. The proverb, "a stitch in time saves nine," applies no where any better than on a gravel road. Constant supervision and repair is the principal secret of the excellent condition of European roads, and of the small cost of maintaining them after they are built, although the thorough manner in which they are constructed is quite a factor.

I am sorry that lack of time has prevented me from offering more than this collection of notes, and I hope to do better at some future day.

Accident on the Arth-Rigi Rack Railroad in Switzerland.

A serious accident occurred on October 20, 1885, on the rack railroad going from Arth, at the foot of the celebrated Rigi to the top of that mountain. The last train of the season consisted of one locomotive, two loaded freight cars and a small passenger car arranged for winter service and therefore provided with windows. All the cars were coupled together and probably also with the locomotive; this, however, is denied. It was done in order that the cars might pass more easily over the less severe grades, which were covered by thick layers of snow. This coupling together of cars and engine is strictly prohibited on the Rigi railroad, and was not justified in the present case, since the engine being in front of the train had already cleared the road, so that there was no danger of the cars being stopped by the snow. It is reported that this rule has been violated several times before on this road. The train in question was run for the purpose of taking down the employés and the office fixtures and books, the road not being run during winter; neither the train superintendent nor a conductor was on the train, and the roadmaster had charge of it. The brakes of the heavily loaded freight cars could not be used, as the cars were loaded with lumber in such a manner, that the hand-wheels could not be reached. A fireman stood at the brake of the passenger car, but it seems that he jumped off before putting on the brake.

The upper part of the road, which was covered deeply with snow, was traversed quite easily by the train, but when it reached the lower end of the Kraebelwand, where no snow was lying, and which is one and a quarter miles from the lower station, the men on the train heard a heavy crack, followed immediately by a great increase of the speed of the train. The laborers standing upon the platform of the car jumped off shortly after they had heard this noise and farther on the roadmaster did the same. The train ran away, passed with lightning speed and deafening noise a distance of about 2,100 feet, including several curves, and left the track a short distance below the watering station Kraebel, going over the precipice to a meadow below. The locomotive turned three times, once lengthwise and twice crosswise, and stood then again upright on the wheels. The freight-cars probably followed the engine and were thrown around its circle of 1,000 feet. The broken coupling was found between the engine and the first freight car. The coupling of the passenger car was also torn off, and the car probably left the track with one wheel soon after the accident; it was thrown entirely off the track further down and stood on its wheels in front of the freight cars; the roof and sides of the car were scattered around. The boiler and the cylinders of the engine remained intact, the rest of the engine being almost entirely destroyed. The track is not damaged to any extent; this proves again how strongly the rack-rails are constructed.

The immediate cause of the accident was a break of the working-shaft, which had an old crevice 7 inches long and about $\frac{1}{10}$ inch deep. This certainly would have been discovered, if the engine had been carefully inspected. The break occurred about 1 inch from the wheel; the wheel turned about five or six times on the shaft, which had become eccentric, and then the shaft broke. After the break had occurred, the main brake became inactive; only the smaller brake on the front shaft could act. But this brake was applied too late; this is proved by the broken wheel being found a long distance below the place where the break occurred. The train then having attained already a great speed could not be stopped by it. But the train could have been stopped if the brake of one of the freight cars had been applied in time.

A similar break of the engine shaft occurred at the same place several years ago, but the brakes were applied at once and the train was stopped. This would have been done this time also, but carelessness of the employés prevented it. The grade of that section of the road is 1,060 feet per mile.

The Arth Rigi Railroad is in operation for eleven years; no accident ever happened there previous to this one. Careful observers, however, expected an accident, as many inequalities occurred among the employés, which could be noticed by the general public, for instance, the conductors, instead of being at the brake during the entire trip, went often into the car to pass the time more pleasantly; trains with two passenger cars were run with only one brakeman; the speed was sometimes increased to 6.25 or even to 7.5 miles per hour.

The Riggenbact system of rack-railroad has been very successful wherever used. But it is necessary to exercise always all possible care and precaution.—*Wochenschriff des Osterreichischen Ingenieur und Architekten Vereins.*

New Process of Manufacturing Car Wheels.—At the works of the Dickson Manufacturing Company in Wilkes-Barre, a new machine and process, patented by J. J. Carr, has been tested with satisfactory results. It is claimed that while on the old method of moulding, casting, dressing and boring the wheels the average product of three men per day of twelve hours is eighteen wheels; with the new process, the same number of men can turn out one perfect wheel every minute, or 720 wheels per day. The principal feature seems to be the substitution of a steel core for one of sand in casting the wheel. This has been tried before, but no one had hit upon a means of getting this core out of the wheel after it was cast. This is now accomplished by a center key, which falls out upon a single stroke of the hammer and lets the steel core drop out, leaving the hole in the wheel perfectly true, and ready to be put upon the axle without any dressing or boring. The sand is run into the moulding boxes by a hopper, and both matrices are moulded and the pattern drawn out by the single revolution of a shaft driven by steam power. The matrices are borne away upon moveable platforms to the cupola and then the piece is cast as under the old process. The moulding is done as rapidly as a revolving disk can carry the boxes under the pressers.

Meteorology of India.—Colonel B. R. Branfill, late of the Survey of India, remarks as a noticeable feature in the meteorology of the southeast coast of that country the frequent lightning storms which occur daily, for weeks together, before the setting in of the southwest monsoon, unaccompanied by rain or by any sound of thunder. They are seen along the coast where the land and sea breezes alternate, and along the line of the Ghats, where the surface-current is thrown up into the upper and opposite current of the atmosphere. In this region the rare phenomenon of interference fringes is very frequently to be seen.

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WE wish to buy all the copies of ENGINLERING NEWS of March 27th and April 3rd, 1886, that are offered, and will pay 12 cents in cash, or send the "Engineers' Field Book" for each copy received.

AT the meeting of the American Society of Civil Engineers at New York, on the evening of May 5, 1886, the Paper, by Edward Bates Dorsey, M. Am. Soc. C. E., on English and American Railroads Compared, recently published in the Transactions will be discussed.

CHIEF ENGINEER JNO. Y. CULYER, of the Atlantic Avenue Rapid Transit Commission, Brooklyn, estimates, in a recent report on the subject, that an underground railway on Atlantic avenue from South Ferry to the city line would cost $8,976,000, and could be completed in eighteen months.

THIS city has been in a state of incipient riot during the whole of the present week consequent on the strike of the drivers and conductors of the Third Avenue Horse Car Line which runs from Harlem bridge to the City Hall. On Monday, the Empire Association ordered a "tie-up" of all the lines of surface railways except on 8th and 9th avenues, and on that day the population of New York had to depend on the elevated railroads, or their own powers of pedestrianism, for transit to and from business.

The subject of wages, we understand, has been agreed upon between the company and the strikers, but the managers of the latter peremptorily ordered the dismissal of several obnoxious non-union drivers and the reinstatement of another. The company would not be dictated to by the association and voted to fight. This they did with the aid of about 1,300 policemen manning the cars and guarding the whole five miles of line; new men were employed, who, although raw at the business, soon learned sufficiently well to take care of it, and at present writing, Thursday, it looks as if the company had won the day. But the Empire Association threatens to keep it up, and order a general "tie-up" of the lines in New York and Brooklyn, the elevated roads and the ferries. Whether they have this enormous power or not another few days will demonstrate. The general sympathy is with the men in their efforts to obtain better wages and fewer hours, but in their tyrannical efforts to dictate as to the conduct of business by the men whose money is invested in it, they have no sympathy from the law and order-abiding American citizen.

THREE bills were passed in the New York assembly at Albany on Wednesday, relating to the annulment of the franchise of the Broadway Surface Railway Company, and were sent to the Governor for his sanction.

The first of the three bills annuls and dissolves the Broadway Surface Railway Company and repeals its charter. The second provides that whenever a street railway company's charter shall shall have been repealed the consents of the local authorities and the order of the General Term confirming a report of Commissioners allowing the construction of the road shall continue in full force and efficacy, and that the right to their enjoyment and use shall be sold at public auction by the Municipal authorities; but the purchaser must be otherwise already authorized by law to construct, maintain and operate a road within the city. The third bill provides for the winding up of the affairs of the corporation by a Receiver appointed by the Special Term of the Supreme Court, who shall take charge of the assets of the company, examine the claims against it, and employ the proceeds of the sale in satisfaction of such of of these claims as are valid.

The lawyers will now be in demand by the innocent holders of the disfranchised securities, who will have to look to Messrs Sharp, Foshay and Kerr for damages. The effect of the legislation which now awaits the Governor's approval will be to deprive Mr. Sharp and his associates of the franchise which they obtained by bribery, to shatter their bogus corporation, and to open the way for suits at law to compel them to disgorge the profits of their enterprise.

THROUGHOUT the New England states, the waters of every brook and stream that can be utilized for manufacturing purposes by the thrifty property owners, are held back by dams, many of which are so cheaply and insecurely built that they are a perpetual menace to the dwellers in the low lands adjacent to them. The fact that most of them survive from year to year, the pressure of the spring freshets or of heavy rainfalls during the seasons, begets a feeling of forgetfulness and a habit of neglect until a day arrives when the little leak through the bottom of the small dam up on the hill-side has weakened the structure by undermining, and the whole reservoir full of water, carrying the debris of the broken dam is let loose upon the adjoining valley. The latest catastrophe of this kind is the breaking away of Mud Pond, a small body of water up in a hill-side in Berkshire county, Mass., not far from the fashionable summer resorts of Stockbridge and Lenox. The dam was ten feet high; the pond was so small as not to be laid down in the maps, and the theory of the disaster is that the ground was so thoroughly soaked with water that probably a small stream found its way through the bottom, and, no one visiting the place, this was unnoticed until the first man was alarmed by the roar of the water coming down the narrow gorge between the hills that led to the Housatonic river. Fifteen years ago the dam was built and since then infrequently visited. At 5 o'clock on the morning of the 20th the dam gave way, and in half an hour what was the pretty village of East Lee, lying alongside of an attractive brook amid the beautiful Berkshire hills, was a scene of ruin and a place of mourning. Houses, mills, bridges, were swept away, seven lives were lost, many people rendered homeless and others ruined financially. The question is raised as to the personal liability of the owners of the pond, but most of them are either insolvent or will be ruined by the disaster.

A special town meeting will be called soon to take action towards repairing the highways. The selectmen estimate the loss to the town at $20,000, while the loss to private property owners is probably $300,000. There are probably dozens of just such dams throughout New England. This disaster will cause an inspection of many of them, but again the close-fisted owners will "take the chances" till the next occasion of a similar accident.

WE are pleased to see that our remarks on the advantages the Congo Free State offers to American enterprise are bearing fruit, citizens of Baltimore having formed the United States and Congo National Emigration Steamship Company to run steamers from Baltimore and intermediate ports to the Congo with a capital of $2,000,000, which may be increased to $3,000,000.

At the commencement of this century Baltimore was abreast of New York in population and commerce. And until thirty years ago the Baltimore clipper carried the commerce of the city on every sea. A too strict adhesion to wooden sailing vessels, while the rest of the country was using steamers, has resulted in the loss of pretty much all of her commerce except the export of agricultural produce. If she turns her attention to the building and sailing of iron and steel steamers, there is no reason why her hereditary skill in marine architecture should not revive, and with it her eminence in commerce.

We have already written at length of the commercial and engineering advantages the Congo offers us, and are glad that Baltimore is to be a pioneer in the field.

Over 5,000,000 bushels of grain are now afloat in the Chicago river waiting for navigation to open, and it is estimated that the amount will reach fully 6,000,000 bushels before the straits are clear of ice.

The rates commenced, with storage, at 4 cents; about the first of March they were as low as 2¾ cents and now they are pretty firm at 3½ cents for wheat.

Vessel owners are hopeful of a good season, as iron ore stocks at lake ports on receipt are lower than usual, and an additional number of furnaces are in blast. As a result mines are being worked to their full capacity, and a large increase in ore consumption is expected. With this prospect some fleets have engaged for the season at from $1.10 to $1.30 from Marquette and Escanaba to Lake Erie ports, and at $1.20 from Ashland to Chicago.

The up freights in Anthracite are expected to be heavy, the amount of hard coal on the docks at Buffalo being large, and one charter has been made at 45 cents per gross ton to Duluth.

The River and Harbor Bill, appropriating $15,120,700 has been reported, and our city papers are commenting on it in their usual liberal minded and truthful manner as "an immense part of which is made up of appropriations for projects which can not claim national or even real local importance," and as usual have to say: "It will be observed that while some states receive an appropriation which in the interest of both national and interstate commerce is grossly inadequate—as in the case of New York harbor with its vast commerce — other states receive excessive amounts."

A Congressman whose constituents are kept poor by wagoning their products over a mountain, is not apt to feel kindly towards a community whose papers, pointing out that there is no commerce on the unimproved stream, argue that there should hence be no improvement.

The New York newspaper is probably the only organism known to nature or art that, year after year, with its head in the lion's mouth trustfully and forcibly twists the lion's tail.

The Hon. John Bigelow on the Panama Canal.

The Hon. John Bigelow, who went to Panama as the representative of the Chamber of Commerce of the City of New York, has just presented his report on that interesting work.

Mr. Bigelow, after detailing in a general way the depth of cutting, etc., thus classifies the most serious difficulties with which the Canal Company has to contend:

First.—The control of the waters of the Chagres river, which, in the rainy season, if unrestrained, is liable to flood the larger portion of the canal every year.

Second.—The cut through the Andes at Culebra.

Third.—Keeping that section of the canal which runs from La Boca toward the island of Perico, in Panama bay, from being filled by the ocean and the Rio Grande.

Fourth.—Securing the amount of labor required at practicable rates.

In regard to the first difficulty, all plans are yet "being discussed;" no work, save that on certain derivative canals, is under construction looking towards the control of the Chagres. Under one of the plans proposed, by which the great Chagres dam is to be dispensed with, these derivative channels may be enlarged so as "to carry off the greatest volume of water by which the Chagres is liable to be swollen." This latter plan would "very considerably" increase the width of these auxiliary canals, and whether it would cost more or less than the dam is a question yet undecided by the new Director-General. At present, Mr. Bigelow says, the presumptions are all in favor of the dam.

The Culebra cut is figured at 22,000,000 cubic yards, and Mr. Bigelow thinks the difficulties are "quite serious." All the works for the construction of the dredges and other machinery were erected at the mouth of the Rio Grande and among the pelistilential mangrove swamps. Plans are in contemplation for damming the Rio Grande and attempting to improve the sanitary conditions of the spot by flooding these swamps.

The question of labor, Mr. Bigelow believes, presents more elements of uncertainty than any other he has encountered in studying this subject; "it is the axis on which the fortunes of this enterprise revolve." The supply of native labor, those who are acclimated, is very limited as the whole population, including the importations of the company, is only 150,000. The labor must, therefore, be imported: most of it thus far has come from Carthagena, Jamaica, and the lower valley of the Mississippi. The main reliance must be upon machinery.

Mr. B. puts the total excavation at 120,000,000 cubic metres; the total done on January 1, 1886, was 13,011,033 cubic metres, leaving six-sevenths of the work unfinished. As to ultimate cost, the unexpended balance, per Count deLessep's report, is $46,000,000; if the French government authorizes the issue of the extra $120,000,000 asked for, the amount on hand to finish the canal will be $166,000,000. One-seventh of the work, exclusive of preparatory expenditures, has cost about $23,000,000 and and the remaining six-sevenths at this rate would cost $138,000,000. On this head Mr. Bigelow says no man living can any more than guess at the amount of work to be done; the plans for the Chagres dam are not matured and the ultimate slope of the Culebra cut is yet to be determined. Add to these the uncertainties of rock to be blasted in the canal channel, the pumping, coffer-dams and multitude of incidentals, and then the important but unknown rate of discount at which the company in its present financial condition must raise the money, and the question of ultimate cost is very obscure indeed.

In looking over the report of Mr. Bigelow we find that we know just about as much concerning the cost of the canal and time of completion as we did before that honorable gentleman went to Panama. He has undoubtedly reported honestly according to his lights; but would not the result of these investigations have been much more satisfactory to Americans interested in the project if a thoroughly competent civil engineer had been sent down to spy out the land rather than a financier and a diplomat? Mr. Bigelow's estimate that the cost of maintenance of the finished canal will not exceed the expenditures at Suez, may be somewhat in error if Admiral Ammen's statement is correct that the Chagres at times rises to a height of 90 feet above the bed of the canal; dams and derivative canals would hardly save the work under these conditions.

Count de Lesseps thinks Mr. Bigelow's statements are "absurd;" and while we admire the Frenchman's tenacity of purpose and grim faith in his own promises, we will simply quote Mr. Bigelow again and say that "it is about as safe to predict the quarter from which the wind will be setting next Christmas at St. Petersburg, as the time when the canal will be finished, or what it will cost."

French Railroads.

During the year 1885 the trunk lines opened a total of 687 miles, and obtained concessions for 548 miles. The system of secondary railroads opened 104 miles and obtained concession for 468 miles. The Algerian system opened sixty-eight miles and obtained concessions for 299 miles; while in the colonies Senegal had a new line of sixty-one miles, and Cochin-China, a new line forty-four miles in length. The total length of line in operation up to December 31, 1884 and 1885 are as follows:

	1884.	1885.
	Miles.	Miles.
Trunk system	18,159	18,816
Secondary system	993	1,097
Algeria	1,046	1,114
Colonies	220	325

Government Officers as Agents for Foreign Factories.

The *N. Y. Tribune* of the 15th inst., makes the following assertions, apparently without contradiction:

There are plans and specifications and estimates in the Navy Department of British and French engine builders, which have been filed there by two Navy officers who have recently returned from abroad, and both of whom are reputed to be financially interested in the works which have furnished the plans and estimates. One of the line officers of the Navy, a lieutenant, who was one of the members of the Gun Foundry Board that recently returned from Europe and made its report, brought with him the credentials as United States representative of William Armstrong & Co. Another officer, a lieutenant commander, who has been abroad on a year's leave of absence, returned recently as the United States representative of the Le Creusot Works, at Le Creusot, France.

Both of these concerns also build guns.

Our Government departments that have control of the arming of our army and navy have long been notorious for the difficulty they presented to the introduction of any improvement, so that our inventors are forced to take their improvements to foreign governments, with results as stated by Captain O. E. Michaelis in his paper on "Heavy Guns," read at the Buffalo meeting of the American Society of Civil Engineers, namely: Professor Treadwell's system of gun construction of 1840, is known as Armstrong's. Krupp has appropriated the Broadwell system bodily, and Eastman's slotted screw-bench plug is known as the French breech-loading gun. Mr. S. B. Dean invented a method of mandrilling bronze guns, which was brought out in Austria as the Uchatius gun, a vast achievment. Hotchkiss has established a large factory near Paris.

The broad and sweeping, but somewhat unsubstantiated charges against the Navy department are notorious.

The cause for this obstructiveness may be partially explained by the educated conservatism of bureau officers, and an article in the New York *Sun* of June 22, 1884, which shows the royalties paid by the South Boston Iron works to members and employés of the Ordnance Bureau, may go a long way towards explaining another portion of the obstructiveness. This state of affairs, which causes us to lose prestige, even among ourselves, and enables agents of foreign manufacturers to procure statements made in American newspapers, to the effect that we cannot hope to make either guns or armor, is scandalous enough, but it seems much worse that officers educated and employed by this Government, one of whom has been sent to inspect foreign works, that he may be a competent adviser to those who have to decide on our armaments, should return with direct pecuniary interests in the advice they give.

Profit of English Iron and Steel Works.

The English letter of the *Iron Age* says that the profits of William Jessop & Sons were for the last year £17,557, out of which £4,000 were set aside for depreciation, and a dividend of 3½ per cent. was declared. The chairman regretted that the year's working had been so unsatisfactory, "but it must be remembered that there had been a general depression of trade."

Charles Cummell & Co., who now have on hand an order for armor plates from the United States government, show net profits of £104,037, which, with the unappropriated balance of last year, makes £124,381. An "interim" dividend of 5 per cent. was paid in October amounting to £26,250, leaving £98,031 for disposal. They also note that, "the depression that has so long existed has un-

fortunately extended over the year 1885 and still exists."

A concern which meets such hard times that it can only earn 19⅝ per cent. on a capital of $2,551,500 seems entitled to sympathy.

In this connection it looks as if it would be better for us if the above mentioned profits had been earned in this country, and were to be expended in developing, say our methods of distribution of various engineering works instead of those of India, for instance.

Ferroid.

In answer to the queries of correspondents, concerning "ferroid," lately introduced, we have ascertained the following: Ferroid is a chemical combination in which iron pyrites and sulphur are the chief ingredients; the compound is patented.

Its original application was as a substitute for lead in laying water-pipe. For this purpose it is cheaper, having only about one-fourth the specific gravity of lead; it requires no caulking; is very fluid and pours easily, and experiments would seem to prove that it expands slightly just before cooling. It is melted and used very much the same as lead, and when cold expands and contracts in the same ratio as cast-iron. The price per pound is about the same as lead, but in bulk it is four times that of lead.

Tests now being completed would indicate that this new material has a very wide field of application in engineering. A cement or concrete made with this ferroid has many advantages. Being a chemical product, the composition of the ferroid is uniform and constant, and it is stronger than brick and as strong as most stone; it is non-absorbent; is ready to sustain a maximum load within half an hour after being laid; is waterproof and acid resisting, hence the elements can have no effect upon it. It can be transported as concrete blocks, of stone chips, sand and ferroid, made into any convenient shape for submarine or underground work, or it can be mixed and placed on the spot.

The following tests have just been made at the Fairbanks Testing Department in this city, and on a Riehle machine:

COMPRESSION TESTS—(FAIRBANKS.)

	Pounds.
Ferroid pure ..... per sq. in.	9,073
" 1 part, sand 3 ..... " "	11,303
" 1 " " 2½, stone chips 3 " "	3,756

TENSILE TESTS (RIEHLE.)

Ferroid pure ..... " "	900 to 1,100
" 1 part, sand 1 ..... " "	1,000
" 1 " " 2 ..... " "	1,000
" 1 " " 3 ..... " "	950
" 1 " " 4 ..... " "	850

TRANSVERSE TESTS—(FAIRBANKS'.)

Ferroid pure ..... " "	1,325

PERSONAL.

ELWOOD LILLY has been elected City Engineer of Mankato, Minn.

W. D. CHEEVER has been elected City Engineer of Anoka, Minn.

CAPT. BURNAM, the oldest lighthouse keeper on the coast, died at Cape Canoval, Fla., on the 20th.

GEORGE B. BUTLER, formerly Secretary of the N. Y. Central & Hudson River Railroad Company, died April 13th, in this city.

HON. JAMES BATTLES has been elected superintendent of the recently completed Aurora waterworks at a salary of $1,000 a year.

ENGINEER WOOD, of Amsterdam, N. Y., has chosen JOHN H. CANNA for assistant engineer and surveyor.

B. S. DE FOREST, a prominent architect of Cleveland, Ohio, dropped dead, April 13th, of heart disease.

WASHINGTON A. ROEBLING, the late candidate for President of the American Society of Civil Engineers, who was defeated, together with the rest of the regular ticket, by an opposition ticket headed by Henry Flad, of St. Louis, has resigned his membership in the society.

G. F. EWALD, of Winona, Minn., who has been connected with the engineering department of the Burlington & Northern R. R., has been appointed first assistant to Chief Engineer Nourse, of the Chicago & Evanston R. R.

BENJ. F. LA RUE, formerly City Engineer of Jackson, Mich., and later Chief Draughtsman of Plum Point Reach Survey, Mississippi River Improvement, has accepted a position as Assistant Engineer with the King Iron Bridge Manufacturing Co., Cleveland, O.

CAPT. HENRY M. ADAMS, Engineer Corps, and CAPTAIN DAVID A. LYLE, Ordnance Department, have gone to Spezzia, Italy, to represent the War Department at the tests of heavy ordnance, to be made there during the latter part of the present month.

C. J. HOOD, F. H. QUIMBY and SAM QUIMBY, three of the members of a surveying party, were drowned recently by the upsetting of a boat while crossing the New river at Sunny Side, W. Va. WM. HOOD, W. A. HAYNES, and the ferryman escaped. They were in the employ of the Chesapeake & Ohio R. R.

CHARLES P. MANNING died at his residence in Baltimore, April 6th, of pneumonia. MR. MANNING was a civil engineer who had been employed for a number of years on Southern lines. He was Chief Engineer in charge of the construction of the Alexandria, Loudoun & Hampshire R. R., now the Washington, Ohio & Western R. R.

MR. CHARLES SACRE, C. E., has signified his wish to retire from the post of chief engineer of the Manchester, Sheffield and Lincolnshire Railway, Eng., which he has held for twenty-seven years, and his engagement will terminate at the close of the current half year. The directors, appreciating the value of Mr. Sacre's professional aid, propose to retain him as their consulting engineer from that date.

WM. F. GARRISON, senior member of the extensive steam-pump manufacturing concern of Guild & Garrison, Brooklyn, N. Y., sailed in the National Line steamer "America" for Europe on Wednesday, the 14th inst. Mr. Garrison goes abroad partly for health and pleasure, also to renew old associations with many of the large manufacturing establishments whose acquaintance he made on a former visit.

O. CHANUTE, formerly Chief Engineer of the New York, Lake Erie & Western R. R., and the chief author of the able and exhaustive report of the Committee of the American Society of Civil Engineers on the Preservation of Timber, has interested himself in the work of tie-preserving, having erected works at Las Vegas, N. M. He is also now engaged in constructing similar plant at Laramie, Wyo., and at Chicago for various parties.

CAPT. THOMAS N. BAILEY, of the Engineer Corps, United States Army, stationed at Willets Point, New York, died on the 20th. He was a native of Tennessee, and was graduated from the West Point Military Academy in 1873, and promoted to the rank of Second Lieutenant, Corps of Engineers. He served as Assistant Engineer on the Geodetic Survey of the northern lakes from June 2, 1874, to August 28, 1876, when he was transferred to the Military Academy as Assistant Professor of Mathematics. He was promoted to the rank of First Lieutenant October 16, 1877, and Captain, March 19, 1884, when he was stationed at Willets Point.

American Society of Civil Engineers.

At the regular meeting, on Wednesday evening, Mr. F. Collingwood in the chair, Secretary Bogart read an announcement of the programme for the Denver Convention as far as it has been arranged. The meeting will take place the last week in June; sleeping-cars, probably of the Monarch Line, will be chartered to run from New York City, to be hauled by the several railroad companies at rates yet to be decided on; Sunday will be spent in Chicago or St. Louis, and the train will arrive at Denver on Tuesday. The meetings will be held Wednesday (President's Annual Address in evening), Thursday and Friday; Saturday, an excursion to Georgetown, Sunday, in Denver; Monday and Tuesday, excursions to Gunnison, Leadville and Colorado Springs; time of absence from New York, about two weeks, and the expense will be quite moderate. In our next issue we will give as full details as are obtainable.

A sketch by Robert L. Harris, M. Am. Soc. C. E., accompanying "Detailed Memoranda with drawings of the Ferry Boat 'Solano,'" used by the Central Pacific Railway at Straits of Carquinez, Cal., by Arthur Brown, Superintendent Bridges and Buildings Department, C. P. R. R., was read: the discussion following was confined to the comparative merits of liquid fuel for steam making.

A paper by A. P. Man, Jr., M. Am. Soc. C. E., "Data for flattening the Ends of Railroad Curves," was discussed in a brief notice by Mr. A. M. Wellington.

The paper by Capt. O. E. Michaelis, Corps of Ordnance, U. S. A., M. Am. Soc. C. E., "A Note on the Cost of Concrete," was deferred to another meeting.

American Society of Mechanical Engineers.

The Spring Meeting of 1886 (XIIIth) of the American Society of Mechanical Engineers, will be held in the City of Chicago, Ills., beginning Tuesday, May 25th, and adjourning Friday, May 28th.

The headquarters of the Society and Secretary's rooms will be at the Grand Pacific Hotel, on the second or parlor floor. The sessions will be held in room "A" of the Grand Pacific Hotel.

By special arrangement, accommodations can be secured for members at the Grand Pacific Hotel for $3, $3.50 and $4 per day, according to location of rooms.

The following papers will be presented for discussion at this meeting:

Wilfred Lewis, "Experiments on Transmission of Power by Belting;" Wm. O. Webber, "Rel. Efficiency of Centrifugal and Reciprocating Pumps;" Horace See, "Production of True Crank Shafts and Bearings;" Geo. H. Babcock, "Substitutes for Steam;" Chas. W. Barnaby, "New Steam Engine Indicator;" F. G. Coggin, "Novel Chimney Staging;" Thos. S. Crane, "Water Purification for Manufacturing and Domestic Consumption;" H. R. Towne, "The Engineer as an Economist;" H. Metcalfe, "Stop Orders and Accounts;" C. M. Woodward, "Manual Training Schools;" O. Smith, "Inventory Valuation of Machinery Plant;" Fred. W. Taylor, "Value of Water-gas and Gas from Siemens Producers for Melting in Open Hearth Furnaces;" Wm. P. Trowbridge, "Ventilation by Heating Chimneys and Fans;" Thos. D. West, "Irregularities in Contraction of Duplicate Castings;" C. M. Giddings, "Dynamometer for Measuring Power required to move Slide Valves;" J. H. Cooper, "Grain Handling in California."

ROCK ISLAND EXTENSION.—The predicted extension and development of the Chicago, Rock Island and Pacific Railroad system is to become a fact forthwith. The company has determined to issue $10,000,000 in new bonds, and contracts were signed in Wall street recently by the terms of which the banking house of Kuhn, Loeb & Co. subscribe for them. The bonds are to be five per cent. collateral trusts, and Kuhn, Loeb & Co. have purchased them at 8 per cent. above par.

President Cable, of the Rock Island Company, has been in the city for several days past on business connected with this big issue of bonds. He talks confidently of the good results to accrue to his company through the use of the money realized from the bonds. Seven hundred miles of new road are projected, the greater part to be known as the Kansas and Nebraska Division. There is much in the programme that does not bode good to competitors of the Rock Island.

HYDRAULIC GRADING.—Please advise contractors having experience and the requisite machinery for "*hydraulic*" grading to send their address to the undersigned, SWAINE & GREENE, Cedar Rapids, Iowa.

CORRESPONDENCE.

Size of Stones in Masonry.

WOONSOCKET, R. I., April 20th 1886.

EDITOR ENGINEERING NEWS:

The article on page 243, current vol. of ENGINEERING NEWS on "Size of stones in masonry" describes a fault often seen in otherwise good work.

If a stretcher breaks it is generally near a joint in the courses above and below thus making a continuous joint through three courses; whereas if it had been originally in two pieces it would have been laid to make a proper bond.

In a recent specification, the work under which is now building, I have the clause, "The length of stretchers shall be between the limits of 2½ and 5 times the rise." This is for a railroad bridge abutments and piers, the face being cut beds, and joints and the backing rubble all laid solid in cement mortar.

I do not recollect to have seen a similar clause in any specification and I would like to learn how these lengths agree with the practice of others.

J. P. SNOW.

The Borough Surveyor's Department, Birmingham, Eng.

The report of Mr. W. S. Till, borough surveyor, on the work of his department during the year 1885, has just been published. It shows that during the year the length of public sewers in the borough has been increased from 186 miles 7 furlong 30 yards to 194 miles 6 furlongs 97 yards. The Cole Valley Sewerage Works, which were commenced in 1883, have at length been completed; the sewage of the Muntz street district has been diverted thereinto from the River Cole, and communications have recently been made by the Drainage Board to the Balsall Heath and the King's Norton authorities as to the diversion of their sewage from the Stratford Road sewer into the new main.

Some of the granite-paved carriage-way will shortly require taking up and relaying, and a special fund has recently been commenced for paying the expense of such works. The wood pavement in New street would have been taken up and relaid during the autumn but for the representations of owners and occupiers of property as to the losses they would sustain; the work in consequence was ordered to be deferred until the spring. The carriage-ways and footways are, speaking generally, in fair repair; a considerable quantity, however, of flagging requires replacing. Wood pavement has been substituted for macadam in that part of Corporation street between New street and James Watt street, the expense thereof being paid out of the amount contributed by the improvement committee for the paving of the carriage-ways of that street and James Watt street. The arrangement with the Improved Wood Pavement Company as to Corporation street was that 9*s.* 8*d.* per square yard should be paid for the pavement, inclusive of 6 inches of concrete; that the company should maintain the pavement free of charge for one year, and for twenty years thereafter at 9*d.* per square yard per annum, excepting in the case of the portion occupied by the tram lines, the maintenance wherof is to be 1*s.* per square yard per annum.

Recently in the laying of tramways, wood has been largely used instead of granite for paving between and on either side of the metals. In many instances it will hereafter be found necessary to pave the remaining portions of the carriage-ways, when wood will also have to be used. This will have the effect of materially adding to the cost of maintenance as compared with that of granite. Up to the end of September, 1885, there were about 130,000 square yards of granite and wood pavements on tramway routes, 35,000 square yards of wood and 225,000 square yards of granite in other streets and roads, while the area of macadamised carriage-ways was about 2,500,000 square yards. The length of declared highways in 1884 was 192 miles 3 furlongs 129 yards. This was increased during the year to 192 miles 5 furlongs 199 yards, and, including the undeclared highways, the total length of streets and roads in the borough was 199 miles 2 furlongs. During the past year five streets of a total length of 1,159 yards were completed by the Council, the owners of property having failed to comply with the notices served on them. The cost of completing these streets amounted to £2,109 4*s.* 8*d.*, and involved appointments on thirty-two owners of property.

The following are the quantities of the various descriptions of materials used in the repair of the macadamized carriage-ways during the past year: Rowley and Bentley stone, 31,629 tons; gravel, pebbles, and grit, 6,918 cube yards. In addition, considerable quantities of screened macadam from tramway routes were used for repairing purposes.

The quantity of water used on the streets and roads and in flushing sewers during the year 1885, was 50,669,720 gallons; 5,978,610 gallons, included in the above, were used for flushing sewers. The water used in 1885 was 1,615,440 gallons in excess of the quantity used in 1884, and was 13,170,146 gallons above the average of the preceding five years. The number of watering machines in use during the year was 3 flushing and 53 ordinary carts, holding 330 gallons each, 1 van holding 380 gallons, and 4 vans of 450 gallons each.

The total number of public lamps under the control of the Public Works Committee on December 31, 1885, was 7,007, and the cost of lighting, extinguishing, cleaning and repairing the same was 11,616*l.* 18*s.* 5*d.* In the night-soil and interception department, it is stated that the number of pans in the borough at the end of the year was 39,935, and that the carrying out of the necessary work appertaining to the department involved the collection during the year of 1,982,307 pans, and 75,086 loads of ashes, whilst 20,285 privies and ashpits, constructed on the old system, were emptied, and 51,192 loads of ashes, etc., were removed therefrom. The number of horses belonging to the Public Works and Health Departments is—Public Works, 91, valued at 3,620*l.* 10*s.*, and Health Department, 128, valued at 4,946*l.* The number of men employed by the Public Works Department on December 31st last, was as under: Repairing, cleansing, etc., streets and roads, 263; stone-breaking, 95; repairing, paving and flagging, 10; flushing, cleansing and repairing sewers, gullies, etc., 51; repairing carts, tools, etc., 12; offices (clerks, surveyors, etc.,) 22; lighting; etc., public lamps, 136; stablemen, 28; total, 617.—*The Architect.*

The Governmental Roads in Italy.

The roads of Italy are divided into state, provincial, community and subordinate roads. The stage-roads belonging to the Government were 5,211 miles long on March 31, 1883, of which 5,053 miles are outside of communities and cities; 9,124 miles of these, more than one-seventh of the entire length, are located in Sardinia. The maintenance of this net of roads cost, from April 1, 1882, to March 31, 1883, $1,505,210 to which must be added $34,607 for cross-roads and $62,243 for superintending, so that the total amount is $1,602,060. 970,978 cubic yards of stone and gravel were used for the roadbed, at an average price of from $1.34 (in Padua) to 23 cents per cubic yard (in Macerata). The standard price for the entire kingdom is 55 cents. 265 chief roadmasters and 2,166 roadmasters are in service; during this fiscal year 263,081 days work were done by common labor. The pay of the roadmasters aggregated $281,521; the length of road under the charge of one roadmaster varied from 2.75 Potenza to 1.25 miles Genoa. The average cost of maintenance for one mile was $308 for the entire kingdom; the maximum was at Modena $752 and at Turin, $697; and the minimum at Siracus $177.50 and Macerata $175.90.

The total area occupied by all the roads is 13,984 acres, of which the graveled roads occupy 9,637 acres. In an average 2.5 cubic yards are used for 10 square feet of roadbed. The maximum amount used on state-roads were on the road from Giglietto to Terranmieva (Caltanisetta) 5.35 cubic yards and the lowest amount of 0.52 cubic yards per 10 square foot of roadbed at Vallarsa (Vicenza); on provincial roads the respective amounts were: 4.87 at and 1.20 at Mantua.

The construction of the state roads and the provincial roads subsidized by the royal government is regulated by special laws. The aggregate length of the state roads in Sicily (according to the law of May 30, 1862), are 586 miles long, of which 213 miles were built previous to the date of that law, 353 miles after that date, 13.7 miles are being built, and the remainder is only projected. The estimated cost of these roads was $4,982,358, of which were paid up to December 31, 1883, the sum of $4,684,976, so that $347,382 remain for the future work. The same law provides for the construction of 107 bridges for provincial roads, with a total length of 34,804 feet; 18,819 feet of this have been built since the passage of the law, 9,230 feet are in course of construction, and 6,755 feet remain to be built. The estimate of cost for these 6,755 feet alone amounts to $1,425,932. The total cost of bridging is estimated at $6,408,292, of which $5,890,317 have been used up to end of 1883.

The state roads of Sardinia (law of July 27, 1862) are in an aggregate, 1,286 miles long, of which 544 miles were built previously to the law; the remainder, with the exception of one mile, were completed before December 31, 1883. The cost of these roads was $6,000,000, while $6,501,265 had been provided.

The state roads of Napoly are 1,112 miles, 570 miles were finished previous to the passage of the law, 468 miles have been finished before the end 1883, sixty miles are in course of construction and 14 miles are yet to be built. The estimated cost was $5,509,618, of which $5,020,000 have been used. The provincial roads in Napoly are subsidized by the State; their total length, 689 miles, of which 20.5 miles were built previously to the laws, 475 miles in 1883; in course of construction and remaining to be built 1,012 miles. The estimated cost is $6,521,348, of which $5,400,000 have been used. The total sum for the Neapolitan roads amount to $12,131,165, to which the state contributes $8,600,000; the remaining sum must be contributed by the different provinces.

BUENOS AYRES PROSPEROUS.—The receipts of the Custom House at Buenos Ayres, for January were $3,310,000, as compared with $2,623,815 in January last year, and $2,000,000 in January 1884. Last year 480 steamers, carrying 553,286 tons of cargo, arrived in the outer roads of Buenos Ayres; 962 sailing vessels also anchored outside. Some months ago there was some talk of creating extensive docks and quays at Buenos Ayres, with a view to save the cost of conveyance by light draught vessels from the outer roads, which often exceeds the freight from this country; but in all probability it has been discovered that the great expenditure which the scheme would entail would make the profit very problematic.

Portable Bridges.

Le Genie Civil, of March 27, contains an illustrated article on the Eiffel system of portable or removable bridges. They are intended for the rapid and easy establishment of communication and are especially recommended for use in the Colonies. In Cochin, China, alone about 8,400 lineal feet of these bridges have already been used, and they were likewise utilized in the Tonkin campaign.

The article quoted, especially describes a modification of the system intended for use on railways of normal gauge, when traffic has been interrupted by accident or in time of war.

The fundamental principle of this system consists in the building up of continuous beams, having an extreme span of 150 feet, by the aid of triangular elements, each identical with the other, and assembled back to back. These triangles are formed of angle-iron connected by gusset-plates riveted together in the work-shop, each element thus forming an indeformable part of the bridge truss. All of the angle-irons making these triangles are turned in the same direction, so that the flat side of one triangle can be backed against the flat side of the other necessary to make, say, one panel of a single intersection truss, the triangles abutting on the median line of that truss.

To build a beam with these elements, it is necessary only to arrange two lines of the triangles back to back with the diagonals crossing each other, and then to connect the lower ends of the triangles by a system of tension members also made of angle-iron. These elements so disposed are tied together by strong bolts, turned exactly to fit the bolt holes so that there is no appreciable play.

To reduce weight in transportation as much as possible, steel is used throughout instead of iron, and the ruling stress permitted is 14,220 pounds per square inch. The running elements of the truss, for railroad purposes, are in form of triangles about 20 feet (6 m.) long and 10 feet (3 m.) high, and they weigh 800 pounds each. These are the heaviest pieces in the bridge. Each truss as erected is terminated by a half-triangle 10 feet long which provides an end post and weighs 638 pounds. The tension members are also in lengths of 20 feet and they weigh 385 pounds each.

With these pieces it is possible to erect trusses of three different types. 1st.—A single truss about 10 feet high, suitable for spans varying by 10 feet up to 40 feet as a maximum. 2nd:—A double truss 10 feet high up to 100 feet span, with the roadway either on the upper or lower chord. 3rd:—A double truss about 19⅛ feet high for spans varying from 100 to 150 feet; with the roadway disposed either as a through or a deck bridge. These elements can thus be assembled in multiples of 10 feet to make bridges from 30 to 150 feet span, according to their arrangement as either single or double systems. In the double system two lines of the primary elements are ranged side by side at a distance of 20 inches between centers. When the height is doubled to form a deep truss, the result is a double-cancellation system in which four triangles are used in making one panel length, these triangles being bolted together through the web connecting the angle-irons at what is then the middle of each post. The floor and lateral system, are made up of built beams bolted in place, with ties in each of the four inside angles of the completed truss.

The weight of a simple 10 foot high truss of 50 feet maximum span is about 600 pounds per lineal foot; for a double system, 10 feet high, suitable for spans up to 100 feet, the weight is 834 pounds per lineal foot, and for a double system of double height, or 19⅛ feet, the weight is 1,120 pounds per lineal foot, good for spans up to 150 feet.

Experience has shown that these bridges are almost as rigid as riveted structures, notwithstanding they are held together by bolts alone. They are rapidly set up in place, either by false-works, or by launching them out on rollers.

Several of these bridges were lately used by the Orleans Railway Company at Ploermel while they were replacing a masonry bridge. There were three spans of about 47 feet and one of 90 feet, resting on timber piers. They were set up ready for use in twenty hours.

THE HISTORY AND STATISTICS OF AMERICAN WATER WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

809. PLYMOUTH, PA.

Plymouth, Luzerne Co., Pennsylvania, in lat. 41° 15′ N., long. 76° 10′ W., is on the north branch of the Susquehanna river, at the lower end of the Wyoming valley at the base of Shawnee or Plymouth Mountain.

The town is over coal mines, and the superintendent of the water company states that as portions of the borough settle a little every day the exact date of settlement of the town can not be given. Water-works were built by a private company in 1876 after plans of W. H. Sturdevant. The supply is taken partly from an artesian well 1,959 feet deep, which flows from 15,000 to 20,000 gallons a day, and the yield of which when pumped is about 150,000 gallons. A further supply is derived from a mountain stream of 2½ square miles water shed, the water from which is impounded in four reservoirs, No. 1 having a cut stone dam, and holding 300,000 gallons, No. 2, a cut stone dam and holding 1,500,000 gallons, No. 3, a stone dam with earth backing, and holding 2,500,000 gallons, and No. 4 a stone dam with earth backing, and holding 5,000,000 gallons. No. 1 is the distributing reservoir, 265 feet above the borough. In dry seasons a further supply is pumped into the reservoir from the Susquehanna river by two Griscom steam pumps, each of 12-inch steam cylinder and two 6½-inch plungers, all of 36-inch stroke.

At the artesian well is a Knowles steam pump with 14-inch cylinder and 8½-inch plunger with 48-inch stroke. Distribution is by fifteen miles of cast-iron pipe of 12 to 2 inches diameter and with 850 taps. Service pipes are of galvanized iron. There are no fire-hydrants. The population in 1880 was 6,065, and is now about 10,000. The daily consumption is 450,000 gallons. The yearly expense of maintenance in 1885 was $3,675. The revenue in 1884 was $12,540. The capital stock of the company is $100,000. The works have cost $85,000.

Draper Smith is President, J. W. Chamberlain, Secretary, and O. M. Lance, Superintendent.

810. NYACK, N. Y.

Nyack, Rockland Co., N. Y., in lat. 41° 10′ N., long. 74° W., is on steep and rocky ground on the west bank of the Hudson river. It was incorporated a village in 1883.

Water-works were built by a private company in 1873 after plans of William Voorhis, taking the supply from springs and from the Hackensack river. The river water is filtered by passing through a flume with two apartments filled with charcoal and one with sponge, and then pumped by a Blake duplex steam pump of 18-inch steam and 9-inch water cylinders of 18-inch stroke, through two miles of 8-inch cast-iron pipe to a reservoir made in excavation, with cemented stone lining, holding 1,000,000 gallons, 275 feet above the pumps and 300 feet above the village. There are four other reservoirs similar to this, at 150 feet above the village, supplied by springs yielding 60,000 gallons a day. Distribution is by eleven miles of cast-iron pipe of 12 to 3 inches diameter, with 315 taps and 27 fire hydrants. Two meters are in use. The town pays $1,350 per year for fire protection. Service pipes are of wrought iron. The population in 1880 was 4,398. The daily consumption is about 60,000 gallons. The capital stock of the company is $100,000 The works have cost $150,000 and the bonded debt is $50,000 at 6 per cent. The cost of maintenance is $500 a year and the revenue from the water-rates, $5,750.

William Voorhis is President and A. M. Voorhis, Secretary.

WATER

COVINGTON, O., is agitating for a supply of good, pure water.

NEWPORT, Ark., is about to put in a system of water-works for general use; mainly for fire protection.

THE street paving now mapped out will cost Decatur Ill., over $75,000.

RALEIGH, N. C., is to be lighted by the Thompson-Houston light. A Westinghouse engine will be employed.

THE Cambridge, N. Y., water-works are now under process of construction, and water will flow by Aug. 1.

WARE, Mass., has appropriated $60,000 for a system of water supply.

HASTINGS, April 15th.—The water-works bonds carried, 301 majority. The whole vote was 629.

THE Tuerk Water Motor Company, of Chicago, Ill. Capital stock, $100,000. August H. Tuerk and others, incorporators.

THE water commissioners, of Northboro, Mass., have voted not to longer employ a superintendent of the water-works.

THE North Attleboro' Steam and Electric Company, Attleboro', Mass. Capital stock, $20,000. George A. Hancock and others, incorporators.

THE Thomson-Houston Electric Light Company, Detroit, Mich. Capital stock, $100,000. John H. Hapgood and others, incorporators.

VICTOR MATHER, D. L. B. Wicks and J. E. Johnson have chartered at Austin, Tex., the Austin Electric Light Co.; capital stock, $25,000.

THE Daft Electric Light and Power Company, East St. Louis, Ill.; capital stock, $300,000. John Scullin and others, incorporators.

W. H. MARSHALL, D. H. Moore and John H. Walker have chartered at Paris, Texas, the Paris Electric Light Co.; capital stock, $25,000.

BROCKTON, Mass., has awarded the contract for lighting the city for five years to the Jenney Electric Light and Power Co. at $150 per light per annum.

RESIDENTS of Jackson county, Ill., are planning to drain a portion of the Mississippi bottoms, thus reclaiming four thousand acres of rich land.

MESSRS. MOFFETT, HODGKINS & CLARKE, of Watertown, N. Y., have proposed to supply water-works for Galesburg, Ill. They approximate 20 miles of mains and 250 hydrants.

WORK has been begun on the conduits on Main, Water, Fulton, and Raymond streets, Brooklyn, which are to contain the twelve cables of the New York and New Jersey Telephone Company. These cables hold 800 wires.

THE Home Water Co., of Little Rock, Ark., will commence on improvements by putting in an entire new plant of pumping machinery, and will lay about five miles of new mains and erect fifty new hydrants.

AT Winthrop, Mass., the question of sewerage is as yet undecided, but is now under consideration. The committee, as a whole, is not opposed to sewerage, but the greater part of them are opposed to it as it is at present proposed.

IN consideration of $7,000, Col. J. W. Baum has agreed to remove the old walls and structure used in digging the Atlanta, Ga., artesian well, to plant in position the pumping machinery, and erect a stand pipe. He is now pushing the work to completion.

WIRES are going under ground in Chicago at a very rapid rate, considering that most of the work of taking them down can only be done on Sunday, when there is little traffic in the business part of the city.

WATER is found in large quantities in eastern Weld county, Col., at from 12 to 60 feet. Up to within a year the cattle companies had frightened away would-be settlers by telling them there was "no water on this rainless plateau."

AT Jacksonville, Ill., there was pumped during the last fiscal year 141,099,199 gallons of water which was 8,260,833 gallons less than the year previous, while the rents amounted to $8,812.38, a gain of $810.62. The cost of pumping, per 1,000 gallons, was about 6¼ cts.

THE Pittsfield, Mass., water commissioners have ordered 1,000 feet of ten-inch pipe to replace a six-inch cement pipe on South street, and 700 feet of four-inch, to use as required, at a low rate for the pipe. They suggest raising the dam at Ashley lake for greater storage capacity.

ROCHESTER, N. H., April 15.—At the regular meeting of the Rochester Aqueduct and Water Company, Frank Jones, of Portsmouth, was elected President; S. D. Wentworth, Clerk; Albert Wallace, Treasurer; Frank Jones, E. G. Wallace, J. W. Sanborn, J. L. Dodge, C. B. Gaffney, Directors. The capital stock is all paid in.

LOS ANGELES, Cal., was founded by the Spanish soldiers, on September 4, 1781. One of the first things they did was to dig an irrigating ditch or zanja. This was the beginning of what is now a magnificent system of irrigation. The ditches aggregate seventy-five miles in length, and they irrigate eighty-five hundred acres of land per month for six months in the year.—San Francisco *Call*.

MINNEAPOLIS PUBLIC WORKS.—During the past year the total length of sewers constructed has been about eight miles, at a cost of $177,910.73; of curb and gutter there have been laid four and one-quarter miles, at a cost of $37,120.29; of granite paving there has been laid nearly one-half mile, at a cost of $29,340; of cedar block paving nearly three miles, at a cost of $77,919.16; of stone sidewalks there have been laid about three miles, and of plank sidewalk about forty miles. The Washington avenue iron bridge over the Mississippi was built at a cost of $105,236.48. Three bridges have also been built over Bassett's creek at the following cost: One at Third street north for $10,634.83; one on the Cedar Lake road for $9,345.46, and one on Western avenue for $2,020.30. Work was also commenced last spring on the North Minneapolis sewer tunnel. Its dimensions are 7 x 7¼ feet. The work on this tunnel was originally let by contract, but owing to some difficulty between the contractor and the city it was taken off his hands, and has been constructed under the direction of the city engineer, by labor employed directly by the city. The whole length of this tunnel will be about 7,000 feet; and up to this time there has been completed 2,514 feet—a little more than one-third of the entire length—at an expenditure of about $68,000. A similar tunnel will soon have to be constructed to enter the Mississippi river at some point near the Chicago, Milwaukee & St. Paul R. R. bridge, to drain portions of wards Six, Seven, and Eight. The water-works affairs are now in a flourishing condition; the machinery and appliances are in good working order, and the present pumping facilities are sufficiently ample to supply the city with water for at least five years to come. There are now laid 534 miles of mains, of which thirteen were put down during the past year. The present number of hydrants is 665, of which 180 were put in during the past year. The number of houses now supplied is 4,709, of which 716 were added during the past twelve months The average amount of water pumped daily is 7,692,507 gallons. For the coming year there have been ordered laid twenty four and a half miles of main and 325 hydrants. The up river steam pumping station has been decided upon and the matter is now progressing. Contracts have been let for the laying of a 24-inch submerged pipe across the Mississippi river at Twentieth avenue north to connect East and West sides, as a large portion of wards One and Three have been inadequately supplied with water for domestic and fire purposes.

WASHINGTON, April 19.—The Supreme Court of the United States to-day rendered the following decisions:

In case No. 188, Johnston agt. the District of Columbia, an action brought by a citizen and taxpayer in Washington to recover damages caused to his house and land by an overflow of foul water from the sewer, the Court decided that the exercise of the duty of selecting and adopting a general system of drainage by municipal authorities being of a quasi judicial nature, is not subject to revision by a court or jury in a private action for not sufficiently draining a particular lot of land, but the construction and repair of sewers according to the general plan so adopted being simply ministerial duties, the municipality which has constructed and owns the sewer may be sued by a person whose property is injured by negligence in constructing the sewer, or keeping it in repair.

No. 15. Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, JAN., 1886.

TOWN AND STATE.	Topography.	Difference of level in town.	In Business District.		Fire Pressure
			Day Pressure.	Night Pressure.	
		feet.	lbs.	lbs.	lbs.
Hot Springs, Ark.	hilly.	100	115	115	115
Hudson, Mass.	level.	35	55	55	55
Ironton, Ohio.	level.	20	40	40	80 to 100
Ishpeming, Mich.	hilly.	30	50	50	80 to 110
Jersey Shore, Pa.	level.	0	55	55	55
Johnstown, Pa.	level.		70	75	70 to 75
Kingston, Mass.	hilly.	60	10	10	——
Lansing, Mich.	level.	0	75	50 to 75	100 to 150
Lebanon, Pa.	level.	0	50	60	50 to 60
Lewisburgh, Pa.	level.	20	45	52	100
Los Angeles, Cal.	undulating.	——	30	35 to 40	30 to 40
Ludington, Mich.	level.	0	30 to 40	20 to 30	80 to 150
Mansfield, Ohio.	hilly.	200	50	50	100
Medford, Mass.	level.	10 to 20	50	60	50 to 60
Middletown, Conn.	hilly.	165	55 to 60	65	55 to 65
Montpelier, Vt.	hilly.	143	135	155	135 to 155
Muncie, Ind.	level.	0	45	45	100
New Brighton, N. Y.	level.	80	85	90	85 to 100
Newton, Kan.	level.	——	40	40	150
Ottumwa, Ia.	hilly.	50 to 200	85	85	——
Peabody, Mass.	undulating.	50	65	85	85 to 90
Rutland, Vt.	hilly.	20 to 50	60	65	60 to 65
San Jose, Cal.	level.	0	20	38 to 40	20 to 40
Truro, N. S.	level.	20	60 to 65	70 to 75	90 to 115
West Troy and Green Island, N. Y.	level.	0	60	65	60 to 65

A COMPANY is being formed at San Francisco, Cal., which plans by one great engineering work to reclaim nearly 1,000,000 acres of flooded and desert land in the upper San Joaquin valley, and improve navigation in the San Joaquin river so as to utilize it for heavy freight. The proposal is to extend north a canal 12 feet deep and forty miles long from Lake Tulare to a unction with the river at the head of navigation. This, it is thought, will permanently lower Tulare lake to 15 feet below its present level, which will reclaim 375,000 acres, including swamp land, all now under water or subject to frequent overflow. The level of the river is 48 feet below the level of the lake and affords a sufficient fall. An additional outlet is also offered by a projected west side irrigation which is to take water from the canal for the irrigation of over 400,000 acres of valley lands, which will thus be vastly increased in value. It is expected the discharge of water into the upper river will improve navigation as desired. It is estimated that owing to the slope of land and favorable character of the soil, the work can be done in two years at a cost of only $1,000,000.

DRAINAGE.—The basis of all road improvement is drainage of surface and subsoil. To obtain this first essential, proceed as follows: If an embankment or grade does not already exist, make one so that the crown thereof shall be two feet higher than the bottom of the broad ditches at sides; it should be at least 20 feet wide with 8 inches crowning. Grade the side ditches so as to carry all flood water to nearest water course. Supplement the foundation thus made by underdrains of first-class tile. When the surface ditches have removed all of the water which will readily flow away through them, the soil will still be sufficiently saturated to make a spongy and unstable base for an embankment. Place parallel lines of tile about three feet below the bottom of the surface ditches, along the base of the embankment, and they will thoroughly drain the lower stratum of soil for the entire road, to a depth of nearly 5 feet below the road surface. As far as the sub-grade of the road is concerned this plan when well executed leaves nothing to be desired. The surface, however, which has absorbed water from the rainfall, and retains it by reason of its puddled condition, is faulty, and can only be made complete by adding a dressing or covering, which shall be both durable and impervious to water. The underdrainage of a road will ordinarily cost about $400 per mile, and for the amount expended no better improvement can be devised for ordinary roads. No smaller than 4-inch tile should be used, and as much larger as the locality and length of the lines may require.—*Prairie Farmer*.

WATER SUPPLY OF SHANGHAI.—The Municipal Council of Shanghai pays the Water-Works Company the handsome sum of 8,000 taels per annum for the water used in the Foreign Quarter for public purposes only, such as street watering, sewer-flushing and fire extinction. The basis of calculation for this payment is, apparently, a consumption of 150,000 gallons per day at a cost of 20 cents per 1,000 gallons—a price which should be amply remunerative to the company, seeing that the natural conditions at Shanghai are favorable to a cheap water supply. The company is now pressing for a larger payment, chiefly on the ground that, owing to the increase of houses and population which has taken place since the original agreement was made, the water now used by the Council for public purposes is a good deal more than 150,000 gallons a day. It is claimed by the Council, on the other hand, that, so far from the limit stated having been exceeded, their present consumption does not approach it. There was a lively debate on this subject at the recent annual meeting of the ratepayers, ending, however, in the rejection of a proposal by Mr. Little to increase the company's remuneration. One interesting point brought out in this discussion was the enormous value of a good high-pressure water-supply, in the protection which it affords against losses by fire. Every speaker testified to this, one of them, Mr. Kingsmill, styling the 8,000 taels a paltry sum as compared with the pecuniary gain to the community, from the reduction in the rates paid by them for fire-insurance, which had been the direct result of the establishment of the water-works. The experience of Shanghai in this respect should be cheering to the community of Yokohama, who are now within measurable distance of a pure and ample water-supply, in some respects superior to that of Shanghai, and who have been burdened for so many years with excessive rates of premium for fire-insurance.—Yokohama *Japan Mail*.

NEWS OF THE WEEK.

Long Island R. R.—The survey for the extension from Locust Valley to Oyster Bay has been completed.

The Chicago, Keokuk and Northwestern Railroad Company has been incorporated to build a line from Chicago via Keokuk to Kansas City or elsewhere.

Buenos Ayres and Rosario Railroad.—The contract for the extension to Sunchales has been approved by the Government.

N. Y. L. E. & W. R. R.—The company will erect a handsome iron structure 600 feet long by 140 feet wide in place of the present frame structure at Jersey City. Work will commence very shortly.

International R. R.—The survey of the line in Maine will be finished about May 1. The original location is to be changed at some points. Construction is in progress on the Canadian border.

The Broadway Arcade R. R. bill (the underground rapid transit four-track scheme, and which may use electricity or other motive power that is not attended by smoke and cinders) passed the Senate April 13—29 to 2.

Cost of Brooklyn's New "L" R. R.—The estimated cost of an elevated structure, such as that planned by the Brooklyn General Rapid Transit Commission, is placed by Engineer Constant at $20,000,000.

The Phillipsburg & Drummond Railroad Company has been incorporated in Montana, with a capital stock of $500,000, to build and operate a line of railroad between the points named.

Lighting Canals by Electricity.—OTTAWA, Ont., April 12.—The Government has decided to illuminate the Lachine canal by means of Edison's incandescent light. It is expected that if this proves a success the Welland and other canals will be lighted on the same principle.

New Indian Railroad.—The Indian Government has ordered a survey to be made with a view to the construction of a railway between Mandalay and Tounghoo, together with an estimate of the cost of the undertaking.

Good Tunneling.—A water tunnel 3,000 feet in length, was completed recently at Riverside, Cal. The work was driven so that when the two forces working from opposite ends of the tunnel met there was not one-fourth of an inch difference in the two divisions.

The Chicago, Rock Island & Pacific Railway Company has signified its intention to build their southwestern line to Wichita, Kan. The line will build on southwest to Wellington and Caldwell, in Sumner county.

The Southern Kansas R. R. will be extended by the A. T. & S. F. Co. from Arkansas City south to connect with the Gulf, Colorado and Santa Fe R. R. It will raise the estimated funds necessary by issuing Southern Kansas 5 per cent. bonds at the rate of $16,000 per mile.

The Janesville & Evansville Railroad Co. has been incorporated in Wisconsin by J. J. R. Reese, Levi B Carle, Charles Atwood, of Janesville; Albert Keep, Marvin Hughitt, C. C. Wheeler and J. B. Redfield, of Chicago, and Charles E. Simmons, of Oak Park. Capital stock, $100,000.

Canadian Pacific R. R.—TORONTO, Ont., April 14.—A despatch from London says that the subscription list for the $20,000,000 Canadian Pacific Railway bonds closed on Tuesday. This was unexpected, and was a day earlier than first announced. It is reported that the applications reached $30,000,000.

Arkansas & Northwestern Railway Company.—The road is to run from Benton county to Clarksville, a distance of 130 miles. The capital stock is $3,600,000, and the Directors are B. R. Davidson, J. W. S. Urman, Charles A. Mulholland, J. D. Van Winkle, M. Coffee, P. F. Davidson, and J. H. Vanhoose, all of Washington county.

The Painesville, Wooster & Ohio Railroad is a new enterprise for a railroad from Fredericktown, in Knox county, to Fairport. A coal branch is also projected from Wooster to Zanesville. The incorporators are Albert E. Boone, Gideon E. Meigs, Frank N. Wedge, Rufus C. Burton, William A. Cassell, Daniel B. Garv, Jr., and John Bane.

The Chicago & Northwestern R. R. has decided to build a river road from Yankton, Dak., up to Blunt or Pierre, connecting the two main lines of their road and running through some of the best farming country. They will keep near enough to the Missouri river to keep out any other line in the future. It is designed to build this season.

The Washington & Potomac R. R. Co. has been incorporated with R. M. Pulsifer as President; Adolphus Merriam, Vice President; James Long, Treasurer, and R. H. Good, Secretary. This company succeeds the Southern Maryland Railroad Company and will complete the road started by them. It will extend from the District of Columbia to Point Lookout, Md., 80 miles.

Macon & Dublin R. R.—The first annual meeting of the stockholders was held March 31st. The reports were satisfactory, and showed that grading was progressing rapidly and at a low cost. A meeting of directors was held and the following officers chosen: D. M. Hughes, President; Hardy Smith, Treasurer, and Iverson L. Hunter, Secretary. Arthur Pou is Chief Engineer.

The Beauford & Northwestern Railroad, to extend from Beauford, Fla., to the Georgia state line, has been incorporated.

The Indianapolis and St. Louis R. R. Co. has been incorporated at Springfield, Ill. Capital stock $4,000,000. Incorporators, Ira James, D. D. James, Justin C. James, James Beatty and James Lee, of Mattoon. They propose to build a line from East St. Louis to Terre Haute Ind.

Railroad Assessments in Iowa.—In Iowa the Chicago, Burlington & Quincy R. R. is assessed on its main line at the rate of $14,500 a mile; the Chicago, Rock Island & Pacific R. R. is assessed on its main line at $12,500 a mile; the Chicago & Northwestern R.R. on its main line at $10,009; the Illinois Central R. R. at $5,500 a mile; the Wabash, Council Bluffs R. R. to St. Louis, $3,000 a mile, and the Chicago, Milwaukee & St. Paul R. R. main line, at $5,800 a mile.

The Louisville Bridge.—The great cantilever bridge at Louisville, connecting with New Albany, has been completed. This bridge presents the only combination of cantilever spans now constructed, and embraces the two longest spans of the kind in the world, one being 483 feet and the other 485 feet in length. The material used in the construction of the bridge was the best steel and wrought iron. The draw span is a piece of workmanship greatly admired.

Cincinnati Board of Public Works.—A special committee of the Committee of One Hundred, of Cincinnati have reported charges of inefficiency and gross neglect in the conduct of the Board of Public Works and Engineering Departments of the city, and severely criticise the past management of the City Solicitor's office. The Committee of One Hundred will decide whether or not to commence proceedings to impeach the above named municipal officers for misfeasance in office.

The Minneapolis & Pacific is the name of a railroad company incorporated two years ago by several rich gentlemen of Minneapolis to build a line of road from Minneapolis to some point on the Red river. The survey was run between the two divisions of the Manitoba to Glenwood or some point in that vicinity. It was stated recently that the money necessary to build the road had been subscribed, and that the contract to build it had been awarded to R. B. Langdon & Co.

The Jacksonville, Tampa & Key West R. R. Co. will soon begin work on an extension of the main line from Sanford, Fla., to Tavares, twenty-nine miles. An extension of the Indian River Division is also proposed, to run from Titusville to Rock Ledge on the Atlantic coast, about twenty-two miles. The company has obtained possession of the De Land & St. John's Railroad, a short branch running from De Land to De Land Junction, and a landing on the St. Johns river; it is five miles long.

Indiana Railroad Co.—INDIANAPOLIS, Ind., April 14—Henry H. Porter, who recently purchased the Chicago and Great Southern Railroad, under foreclosure, for $501,000, has organized a new company to operate the road, which runs from Fair Lake, Jasper county, to Yeddo, Fountain county, a distance of eighty miles, where it connects with Mr. Porter's newly built road to Brazil, giving him a coal road directly into Chicago. The new company is called the Indiana Railway Company. Its capital stock is $5,000,000.

The Chicago & West Michigan R. R. Co. will this year extend its line from Baldwin, Mich., the present terminus of the Newaygo Division, northward to Traverse City, and will also extend its main line on the southern end from the present terminus at Lacrosse, Ind., southward about three miles, to a connection with the Chicago & Atlantic R. R. It also proposes building a branch from the Traverse City extension to Frankfort on Lake Michigan, and is considering the question of a branch to Cadillac, to be hereafter extended to Alpena building on Lake Huron.

Pennsylvania R. R.—The company has given instructions to complete the survey at once between Curwensville and Mahaffey's. If this road should be built, it will open up another line of trade to the Pennsylvania, and, with the Houtzdale branch, will almost circumscribe the district drained by the Vanderbilt system in Clearfield county, Pa. Twelve surveyors, in charge of Chief Engineer Emile Low, have begun lining out the new branch between Hazleton and Nescopek. The distance is twenty seven miles, has a number of twelve-degree curves in it near Rock Glen, and, with the exception of six miles now used at Tombicken, will cost $50,000 to the mile. The Pennsylvania scheme covers the twenty miles from this point to Mahonoy City, and the Lehigh Valley R. R. meets it by a survey of a thirteen-mile road to Delano, both of which will be built this summer. The busy shoe manufacturing borough of Orwigsburg is making strenuous efforts to have the Pennsylvania Railroad construct a branch road three miles long to connect with the Pennsylvania. Schuylkill Valley Railroad at Landingville.

An Electric Brake.—Col. Flad, City Engineer of St Louis and President of the American Society of Civil-Engineers has invented an automatic electric air brake which will stop a train instantly, and when the electric circuit is broken by the uncoupling of a car, the whole train, including the detached cars, is stopped by the brake working automatically. The Baltimore and Ohio Railroad consented to experiment with the brake last week, and the result being very satisfactory, they resolved to use the brake for six months on one of their trains, for the purpose of ascertaining whether the invention will stand the test of time.

Denver, Aspen & Grand River R. R.—Work will be commenced at once. A corps of engineers and assistants, with a complete working outfit has left Denver for Leadville under charge of Chief Engineer King of the Denver & Rio Grande R. R. This new road will be a connecting line between the mines at Aspen and the Denver & Rio Grande R. R. The trustees for the first year were Addison Cammack of New York, D. H. Moffatt, W. S. Cheesman of Denver, W. L. Scott of Erie, Pennsylvania, Josiah C. Reiff, Ad. Engler and J. B. Chaffee. The capital stock of this corporation was fixed at $500,000. The proposed route is: From Red Cliff through the valley of the Eagle river to its junction with the Grande river, from thence to junction of the Gunnison, then westward to Utah.

N. Y., West Shore & Buffalo R. R.—Grading has been begun for the new tracks of the West Shore road extending from Weehawken to the main line of the Pennsylvania R. R. near the Harsimus junction. The line of track is about three miles in extent, and will be used as an outlet for passenger business, thus avoiding the present long ferriage transfer made necessary from near Guttenburg down to the foot of Jay street. The construction will necessitate some very heavy engineering work. First there will be a heavy cut along the foot of the Palisades, and then the construction of a bridge with a 65-feet span over the Erie R. R. at the mouth of the Bergen tunnel. The horse-car tracks of the Pavonia Line will be crossed at grade and then a tunnel will be constructed under the Newark avenue hill. From this on it will be easy work, at a slight grade, to the point of connection with the Pennsylvania R. R. near the Point of Rocks. Unless some unexpected obstacle is met with, it is expected that the work will be completed by the latter part of July.

Bridging the Big Rivers.—Bills have been passed by the House authorizing the construction of bridges as follows: Across the Mississippi, near Alton, Ill.; across the west channel of the Detroit river to connect Belle Isle Park with the main land; across the Tennessee river, by the Nashville, Jackson & Memphis Railroad Co.; across the Mississippi river near Keithsburg, Ill., across the Illinois and Des Moines rivers, by the New York and Council Bluffs Railroad Co.; over Bayou Barnard, Miss.; across the Red river near Brown's ferry, Tex.; across the St. Croix river at some accessible point between Prescott, Wis., and Taylor's Falls, Minn.; across the Mississippi river at Winona, Minn.; across the Missouri river at St. Joseph, Mo.; across the Missouri at Council Bluffs, Iowa; across the Missouri river at Saline, Mo.; across the Missouri river at Clay, Mo.; across the Missouri river above St. Charles, Mo.; across the Yellowstone river, Mon.; across the Mississippi river at Red Wing, Minn.; across the Missouri river near Atchison, Kan.; across the Tombigbee river at Warrior, Tenn., and other navigable rivers in Alabama, by the Gulf and Chicago Air Line Railroad Co.; across Young's bay, Ore.; across the Missouri river near Chamberlain, Dak.; across the Missouri river at Pierre, Dak.

The Northern Pacific R. R. Co. has decided to complete the remaining seventy-five miles of the Cascade Division at once. In order to facilitate travel it has also decided to construct a switch-back over the mountain to be used until the tunnel is completed. This switch-back will probably not exceed $200,000, and the material can be used elsewhere afterward. This will give a direct line across the continent without making the southern detour to Portland. The tunnel cannot be completed inside of two years, but the switch-back can be laid and the operation of the division commenced by this time next year at the latest. The action of the board was made known in St. Paul by the receipt of the following telegram from President Harris to General Manager Oakes:

"Please arrange for the invitation of proposals to complete the grading between Ellensburgh and fiftieth mile, Greene river, including a switch-back over the mountains."

The Cascade division extends from Pasco junction to Tacoma, a distance of 248 miles. Of this 175 miles have been built—fifty east from Tacoma, and 125 west from Pasco junction. There are uncompleted seventy-three miles, including the tunnel. Forty-four miles of this are this side of the tunnel, and twenty-seven the other side. It is for the building of these gaps that proposals are to be asked.

Chignecto Ship Railway.—A resolution presented by the Minister of Railways has been adopted by the Dominion House of Commons providing change in the condition of the subsidy of nearly $4,000,000, granted by the Government for the construction of a marine railway, twelve miles long, across the Chignecto isthmus from the bay of Fundy to the straits of Northumberland. The minister explained that the railway would be used by fishing vessels and vessels engaged in the trade with Boston and New York, and St. Lawrence boats.

Niagara Falls & Whirlpool R. R.—Engineer Shields has completed the survey; and found that it is just a mile from the whirlpool terminus of his line to the race at Witmer's Mill, and it will be two miles from there to the Falls terminus, at the old Maid of the Mist landing. He says that after the right of way is secured, the track can be laid in sixty days. The company has had overtures from a New York electric company, which desires to furnish motive power for the railway, and it is very probable that it will be accepted, as the track will pass near unused water power sufficient to operate a hundred such roads.

The Galesburg & Rio Railroad Company has been incorporated to construct a line from a point on the line of the Chicago, Burlington and Quincy Railroad, within or near Galesburg, Ill., northerly to a connection with the St. Louis, Rock Island and Chicago Railroad Company's tracks, at or near Rio Station, in the same county; the principal offices to be in Galesburg and the capital stock $260,000. The first Board of Directors is composed of L. O. Goddard, Frank S. Bogg, W. J. Fabian and J. L. Lathrop, all of Chicago, and Charles W. Darrow, of South Evanston. The proposed road is understood to be merely a short connecting line for the Chicago, Burlington and Quincy.

St. Louis, Arkansas & Texas Railway Company.—Capital stock $12,500,000. This company is organized for the purpose of constructing and maintaining a line of railroad commencing at Birds' Point, Mo., on the Mississippi river, opposite Cairo, Ill., to Texarkana, Tex. The line through Missouri will be 74.7 miles. The length of the line in Arkansas will be 354.6 miles. The articles of association also provide for the construction of a branch from Pawpaw, Ark., to New Madrid, Mo., and also a branch from McNeil, Ark., to Magnolia, Ark. S. W. Fordyse, of Hot Springs, Ark.; H. S. Allis, of Little Rock; J. W. Phillips, S. A. Bevar, Wm. M. Senter and P. C. Kerens, of St. Louis; J. H. Benedict, J. C. Reiss and F. K. Benedick, of New York, compose the first Board Directors.

Windsor Lock's Bridge.—The new bridge recently completed, over the Connecticut river, is a wire suspension structure, carried on four iron towers measuring 50 feet to the saddles, and resting on two piers of solid masonry 35 feet high. The cables are each composed of seven 2-inch galvanized steel wires, the ropes bound together with cable bands at intervals of 7 feet. The center span of the bridge is 547 feet, and the land spans 301½ feet each, making the total length between the abutments 1,150 feet. The width is 20 feet, and the camber of the arch 11¾. The iron work, including the trussing and the towers, was made by the King Bridge & Iron Company at Cleveland, O., and the cables and wire work were furnished by the John A. Roebling's Sons Company, of Trenton, N. J. J. W. Shipman, of New York, was the contractor, bidding $55,000 for the work. The work was begun early in July, 1885, and according to the contract stipulations was to have been finished by January 1 last. The contractor is supposed to have been unfortunate in making his bid too low, and the actual cost of the work has probably exceeded the sum named by several thousand dollars. Mr. Shipman has now given over the work to the charge of the Roeblings, who will put the finishing touches on his work. The total cost of the bridge is not by any means covered by the $55,000 named.

CONTRACTING.

Gravel.—In Butte, Mont., 38 cents per cubic yard was bid for laying gravel on the street.

Ohio River R. R.—The contract for all the bridges has been let to the Phœnix Bridge Company, of Phœnixville, Pa. The road is to be completed this fall.

Bridge Abutment.—Bids for the abutment work at the Brush creek aqueduct bridge, Portsmouth, O., were from $4.47 to $7.45 per cubic yard.

Grading and Graveling.—At Springfield, O., Messrs. Mills proposed to do the grading at 16 cents per cubic yard and the graveling at 35 cents per cubic yard, or the whole job for $975. James Wyant's bid was 23 cents per cubic yard for grading and 49¾ cents for graveling.

Tunnels.—On the line of the Montana Central R. R. in Prickly Pear canyon, there are two tunnels to be built, one 600 and the other 300 feet in length. W. H. Green, of Helena, has been awarded the contract for boring both holes.

Flowage Basin.—The successful bidders on the work of improving shallow flowage basin 3, Boston, Mass., were as follows: Sections A, B, C and D, to Neal McBride, of Waltham, at 27 cents each, except C, upon which he bid 34 cents; sections D and E to J. H. Munson, of Boston, D, at 29 cents and E, at 31 cents.

Welland Canal.—The following completes the list of contractors for deepening the Welland Canal: K north, R. T. Sutton, Toronto; K south, John Conlon, Thorold; L, M and N, Isbister & Reid, Ottawa; O and P, F. B. McNamee, Montreal; Q R S, and T C. F. Dunbar & H. T. Dunbar, Humberstone, Ont.

The Vienna Metropolitan R. R.—The official *Weiner Zeitung* announces that the concession granted to Mr. Fogerty some five years ago for the construction of the Metropolitan Elevated Railroad has now lapsed, owing to the fact that the English syndicate represented by Mr. Fogerty has not fulfilled its part of the contract. It would appear that the caution-money deposited by the syndicate, amounting to about 1,000,000 florins is forfeited.

Spokane Falls & Palouse R. R.—The contract for building the road has been awarded by Chief Engineer Anderson to Nelson Bennett. Mr. Bennett is now building the tunnel through the Cascade mountains. Among the other bidders were Billings, Bailey & Kinnaird and the Corey Bros. W. H. Small of Walla Walla was awarded the tie contract. He is already at work on his contract, and Mr. Bennett is expected to commence grading very soon.

Asphalt Paving.—The bidders for laying asphaltum pavment in Cincinnati on Race street and portions of Fifth, Main and Court streets were: Michael J. Dady, New York; Wm. F. Shanks, Louisville; Chas. M. Steele, Cincinnati, and Warren-Scharf Asphalt Paving Co., New York. Each bidder was required to file a sample of asphalt. The bids ranged from $2.90 to $4.10 per square yard for asphaltum, and were all referred to the Committee on Streets, who, in connection with the City Engineer, will compute the bids.

Baltimore Contracts.—The contract for furnishing Baltimore with iron gutterplates for the ensuing year was awarded to J. Vernon Campbell at 15-16 cents per pound. The contract for furnishing 93,000 Belgian blocks to the City Commissioner's Department was awarded to McClennahan & Bro., to furnish 50,000 at $54.50 per thousand, and to William F. Weller for 25,000, at $54.40, and 18,000 at $56.95. The Baltimore Dredging Company was awarded the contract for dredging a portion of the falls for $20,000

Street Cleaning.—Street Cleaning Commissioner James S. Coleman and Deputy Controller Storrs, representing the Controller on Wednesday opened bids for cleaning the first and second street cleaning sections of this city. The following bids were received:

Harlem Bridge Bids.—At their meeting, Thursday, the commissioners produced fifteen bids. Only one offer was made to build the whole structure. That was proferred by the New Jersey Steel and Iron Company for $2,596,750.19. Ten offers were received for the mason work, as follows: Miles Tierney, $1,390,841.90; John McQuade, $1,093,407.60; William H. Browne, $1,258,996.40; Boller & McGaw, $1,396,025; John Cox & Co., $1,401,640.02; Smith, Ripley & Drake, $1,420,000; Guidet & Darragh, $1,697,693.77; Belden, Soule & Wright, $1,628,889; W. S. Coleman, $1,433,261, and Rider, Dougherty & Co., $1,288,154.66. Five contractors offered to do the metal work. Their bids were: King Iron Bridge & Manufacturing Co., $1,180,000; Phœnix Bridge Co., $1,116,000; Union Bridge Co., $687,500; the Passaic Rolling Mill Co., $880,152, and the New Jersey Steel and Iron Company $809,155.23. The lowest bidder for the mason work was John McQuade, whose offer was $1,093,407.60, and the lowest for the metal work was the Union Bridge Company at $687,500. These two offers would make the whole bridge cost $1,780,907.60. The commissioners, however, reserve the right to make any change they see fit, so that this offer by no means shows what the bridge may cost.

Bidders.	*First Section.*	*Second Section.*
Joseph C. Biglin	$118,800	.....
F. Theodore Walton	129,000	$215,300
Michael J. Dady	130,000	220,000
Arthur A. McLean	120,000	.....
J. S. Brown	137,000	219,000
Michael Kane	136,000	232 000
J. J. Halleran	.....	209,000
W. T. Hayward & Edward Duffy	117,490	214,490
Philip Brady	.....	170,000
Seymour G. Smith	.....	180,000
Michael J. O'Reilly	.....	204,900

Mr. Virgilio del Genovese, a contractor, of No. 268 Bowery, filed a protest against the award of any contracts for the work on the ground that he was not permitted to see the specifications as provided by law. The first district embraces that part of the city west of Broadway below Fourteenth street, and the second that part east of Broadway.

The Chicago, Milwaukee & St. Paul R. R. Co. has awarded contracts to D. C. Shepard & Co., of St. Paul, for the grading of the following 102 miles of new line in Dakota: From Scotland west, thirty-four miles; from aforesaid line to Mitchell thirty-four miles, and from Ipswich west, thirty-four miles. Scotland is situated twenty-seven miles northwest of Yankton, and is the terminus of the Sioux City & Dakota division. Ipswich is the western terminus of the Hastings & Dakota division. The grading will be completed this season.

Water Pipes.—The Shickle, Harrison & Howard Iron Company were this week the successful bidders for 5,600 tons of water pipes for St. Louis. There were three bids, as follows: Camden Iron Company, $167,456; Cincinnati and Newport Iron and Pipe Company, $156,000; Shickle, Harrison & Howard Iron Company, $148,008. The bids for 170 tons of special castings, which were as follows, were also awarded to the same company: Camden Iron Works, $10,608; St. Louis Iron and Machine Works, $9,350; Shickle, Harrison & Howard Iron Company, $7,480.

Denver, Memphis & Atlantic R. R.—S. H. Mallory, of the contracting firm of Fitzgerald & Mallory, has made a contract with H. L. Fox & Co., of St. Louis, for 200 miles of railway material for the Denver, Memphis, & Atlantic, for the grading of which line Messrs. Fitzgerald & Mallory have already sublet contracts for Labette county, Kan., and also ordered 40,000 ties, to be delivered at Chetopa this week. The contract with Messrs. Fox & Co. includes 6,000 tons of rails, which will be turned out by the Western Steel Company, of St. Louis. The steel-works, which have been shut down for some time past, will be opened up on this contract, which in the aggregate involves $2,000,000.

Pipe and Castings.—Bids were opened at Newark, N. J., recently for furnishing 15,000 feet of 6-inch and 2,000 feet of 4-inch pipe. They were as follows: Sayre Pipe Foundry, Sayre, Pa., 6-inch pipe $31 per ton; 4-inch, $33; John Fox, New York; 6-inch, $32; 4-inch, $34.50; Warren Foundry Company, 6-inch, $28.80; 4-inch $30.50; H. H. Taylor, Allentown, Pa., 6-inch, $30.90; 4-inch, $31.90; R. D. Wood & Co., Philadelphia, 6-inch $31.40; 4-inch, $31.80. The contract was awarded to the Warren Foundry Company. A number of bids were opened for new boiler fronts, valves and castings for the Chatham street pump house. The contract was awarded to the Hewes & Phillips Iron Works for 4¾ cents per pound for boiler fronts and dampers, 3½ cents for castings and $130 for gauges and valves. The resolutions offered by Commissioner Seymour at the last meeting in regard to having all laying of pipes, etc., done by employés of the Board, instead of by contract, were taken from the table and passed.

Asphalt Pavements Recommended for St. Joseph, Mo.—According to the St. Joseph *Gazette*, a delegation of citizens of that place recently visited Omaha to examine its pavements and to recommend a suitable material and system for the proposed improvement of the streets of St. Joseph. The delegation was handsomely received and found the prominent citizens of Omaha almost unanimously in favor of asphalt pavements. The St. Joseph delegation in its report to the citizens of their own town, state that after careful examination they would sum up their impressions of Omaha pavements as follows: Sioux Falls red granite was undoubtedly the most durable, but this is its chief and only merit; it is rough, noisy and trying on animals and vehicles. On streets of steep grade or little traffic the cedar block was reasonably satisfactory from its cheapness and smoothness. Trinidad asphalt, as laid in Omaha by the Barber Asphalt Co., they regarded "as the best paving material known," and they then proceed to cite its many recognized advantages. In conclusion the delegation unanimously recommended Trinidad asphalt pavement as best suited to the requirements of St. Joseph.

Drainage Ditches.—N. H. Colwell, C. E., will on April 30th and May 1st offer for sale by sections at public outcry at Kenton, O., court house, to the lowest and best bidder the work of constructing several ditches in Hardin Co., Ohio. There will be on April 30th a total of excavation sold of 24,270 cubic yards, and on May 1st a total of 121,950 cubic yards, of which 950 cubic yards belong to one ditch (the Cotton Wood Ditch) six miles in length. The following refers to this ditch: The entire distance of the ditch including the lateral is about six miles, and the widths of the base is as follows, to-wit: From station 0 to 11—8 feet; from 11 to 21—10 feet; from 21 to 60—12 feet; from 60 to 272—14 feet, and from 272 to 306 at Scioto Marsh Ditch—16 feet. Base of the lateral is 2 feet. The depth of cutting in the marsh will average about 6½ feet. The slope shall be one and one-half to one; if the ditch is made with a dredge which cannot make this slope, the mean width of said ditch shall be cut as taken from the engineer's report. The estimated cost of this ditch is $16,000 which includes $455 for clearing. Work will be paid for in cash when completed. For further particulars address N. H. Colwell, Kenton, Ohio.

Market Report of Engineering Materials.

New York April 22, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.		
Angles	1.95c	@ 2.10c
" steel	2.35	@ 2.45
Tees	2.35	@ 2.40
Beams and channels, American	3.0	@
Tank Plates	2.15	@ 2.20
Shell Plates	2.4	@ 2.5
Steel plates, Tank	2.5	
WROUGHT-IRON PIPE. PITTSBURG.		
Butt welded, black Discount	42½	@ 45
" " galvanized "	32½	@ 35
Lap welded black "	60	@ 62½
" " galvanized "	42½	@ 45
Boiler tubes "	55	
RAILS.		
Steel (large lots at mill)	$34.00	@ $35.00
Old rails	19.00	@
Old rails, steel	22.00	@ 23.00
R R. spikes	2.25c	@ 2.40c
R R. splice-plates	1.75	@ 2.00
R R. track bolts, square nuts	3.00	
Barb-wire fencing, galvanized		5.00
" " painted		4.00
Corrugated iron		
Nails		
Iron, per keg	2.35	@ 2.45
Steel do.	2.55	@ 2.60

METALS.

COPPER.		
Lake Superior	$11.25	@ 11.30
Other Brands	10.00	@ 10.12
LEAD.		
Com. Domestic	4.70	@ 4.80
Lead Pipe	.06¼c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	$5.50	@ 5.70

BRICK.

Cargoes (afloat)		
Haverstraw per M.	8.12½	@ 8.50
Fishkill		
Up-River	7.75	@ 8.25
Jerseys	7.25	@ 7.75
Long Island		
Pale	4.25	@ 4.75
FRONTS.		
Croton, red	12.00	@ 15.00
" dark	12.00	@ 15.00
" brown	11.00	@ 14.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85.00	@ 120.00
Fire brick	24.50	@ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be Wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@ $3.00
BAETJER & MEYERSTEIN:		
Hanover Portland	2.60	@ 2.65
BELLONI & Co.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
K. B. & S.	2.55	@ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@ 2.60
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.65	@ 2.90
K. B. & S. " "	2.75	@ 2.95
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
FISHER, ERSKINE W.:		
Stettin (German) Portland Cement	$2.40	@ 2.75
GABRIEL & SCHALL:		
Vorwohler "Lion"	2.65	@ 3.10
HUDSON RIVER CEMENT Co. Rosendale		1. 0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.40
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
MARCIAL & Co.:		
J. B. White & Bros. Coarse	4.50	@ 5.00
" Fine	8.00	@ 10.00
" Portland	2.45	@ 2.85
NEW YORK CEMENT Co.:		
Rosendale		1.20
N. Y. & ROSENDALE CEMENT Co.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAMSON:		
K. B. & S.	2.35	@ 2.60
STANDARD CEMENT Co		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT Co.:		
Windsor	1.00	@ 1.10
Standard		1.15
Cabler's Portland	2.15	@ 2.40
UNION AKRON CEMENT Co.:		
Akron "Star" brand.		

ASPHALT.

ROCK.		
Prices range per ton	$15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.50

LIME.

Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	.95	@ 1.00
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " " "		
Brown stone, Portland, Ct. "	1.00	@ 1.35
" Belleville, N. J. "	1.00	@ 1.35
Granite, rough	0.45	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
" Choice "	65.00	@ 70.00
Tally plank, 1¼ in, 10 in. dres'd. each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	20.00	@ 22.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2½ × 4 to 4 × 6 in	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30,00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "	5.75	@ 6.00
" sawed 18 in. "	2.00	@ 2.25
LATH, Cargo rate		

PAINT.

Lead, white, American dry per lb	.04¾	@ .06
" " " in oil pure "	.06¼	
" English, B. B. in oil	.08¼	@ .08¾
" Red, American	.05¼	@ .05¾
Litharge "	.05	@ 05½
Venetian red, American "	.01	@ .01¼
Indian red "	.05	@ .10
Vermillion, American lead "	.10½	@ .12½
Paris green "	.15	@ .20
Umber, Amer. raw and powdered per lb.	.01¼	@ .01¾
Drop black, Amer. "	.07	@ .13
" Eng. "	.11	@ .13
Chrome green	.05	@ 20
Oxide zinc, American	.03¾	@ .04
" French	.06	@ .08

Trade Notes.

THE Gloucester, Mass., Iron Works have a contract for 800 tons of pipe for a firm in Cairo, Ill.

CAR BUILDING seems to be pretty lively just now. It is reported that in about fifteen shops orders are booked for 11,000 cars with the prospect of 4,000 more very soon.

THE Indianapolis Car Works have been awarded a contract for some 25-ton capacity cars for an Ohio railroad, the cars to be of the same pattern as those built for the Ohio Southern R. R.

THE Western Steel Company, of St. Louis, Mo., has sold 6,000 tons of steel rails to the Denver, Memphis & Atlantic Railroad, delivery to be made by June 15th.

THE Chattahoochee Brick Co., of Atlanta, Ga., are very busy. They have a capacity of 200,000 brick together with various shapes and are turning out this number daily.

RUSSIA either finished or had in various stages of completion last year 23 vessels for her Baltic and Black sea fleets, and considerable additions were made to her steel armor manufactories.

THE Pratt & Whitney Co. have nearly completed the order of the Italian Government for 100 Gardner guns, and also 12 of the same guns for our own Government.

THE Wason Car Works at Chattanooga, Tenn., are busy completing the order received from the Briarfield Coal and Iron Co. for 10 30-feet standard-gauge coal cars. Work was resumed on the 7th.

THE Tanner & Delaney Engine Co., of Richmond, Va., has just shipped five locomotives—one to be used near Cincinnati, one for Sunbury, N. C., one for Manning, S. C., and two of the new style pole railway locomotives for Alabama and Florida.

MESSRS. P. MATHESON & SON have decided to remove their Tube and Pipe Works from Middletown, Pa., to Youngstown, O., the Ohio Gas and Fuel Co, guaranteeing an ample supply of gas. The erection of the necessary buildings, which will cost $150,000, will soon be commenced.

TWO labor bills have passed the House in the Connecticut Legislature, one providing that no child under 13 years of age shall be employed in any manufacturing, mercantile or mechanical establishment, the other requiring weekly payments of wages by every manufacturing, mercantile and railway corporation.

THE Cleveland Bridge and Iron Company, Cleveland, O., report business about the same as last year.

THE Mason Machine Works, Taunton, Mass., are building two locomotives for the Old Colony R. R.

THE Detroit Bridge and Iron Works, Detroit, Mich., report trade fairly active, having orders in hand to insure full operation for some months to come. As their product goes so largely into railway work, the southwestern strike has to some extent interfered with orders for new work.

The Department of Public Works of Italy has approved a proposal to ask tenders for the rails, etc., required for certain subsidiary lines, comprising 11,487 tons of rails and 12,125 quintals of accessories, in 11 lots, and the estimate is 2,297,000 fr. for the rails, and 404,337 fr. for the accessories.

THE Pennsylvania Steel Works at Steelton, Pa., in the month of March turned out 20,862 tons of Bessemer steel. The blooming mill bloomed during the month all the product of the Bessemer mill in addition to some ingots from the open-hearth furnace, making a total of 21,886 tons for the month. The heaviest output made in any one day was 926 tons in 24 hours.

TOTTEN & Co., of Pittsburg, Pa., have an order from the Columbia Iron and Steel Co., Uniontown, Pa., for a modern improved blooming mill. It is to be adapted for the Clapp-Griffith as well as the Bessemer process. They have also contracted for a beam and structural iron train adapted to rolling beams, channel bars and shapes of large dimensions.

THE returns of the Association of German Iron and Steel Manufacturers show that the pig iron production of the German Empire, inclusive of Luxemburg, during February was 269,401 tons, including 133,247 tons of puddling pig, 9,833 tons of spiegel iron, 35,452 tons of Bessemer pig, and 28,046 tons of foundry pig. The production of February, 1885, was 296,927 tons. From January 1 to February 28, 1886, the production was 568,350 tons against 616,728 tons in 1885.

DURING the month of March there have only been 10 vessels of 8,169 tons, launched on the Clyde, and of these one vessel launched at Dumbarton was itself 5,500 tons. Judged from the output for March, the shipbuilding trade has never been in so depressed a condition as at present since the time of its first becoming of any importance. Only three times since January, 1874, has the monthly output been so small—namely, in July, 1878, when the figures were 8,100 tons; in July, 1879, when they were 7,767 tons, and in January, 1884, when they were 6,672 tons; but owing to the holidays, work in January and July only extends over a fortnight, so that the diminished output in those months is partly accounted for.

THE "Jornal do Commercio," Brazil, announces the arrival at Imbituba of the first train of coal extracted from the mines of Tubarao in the province of Santa Catarina. The Tubarao Brazilian Coal Mining Company, the concessionaires of the mines, have had them properly examined by Mr. S. R. Gilroy, a well-known mining engineer. In the report presented the quantity of coal available in the Rio Bonito mine has been estimated at 38,787,775 tons, which would produce 1,000 tons per day for 129 years of 300 days each. Another mine, the Barro Branco, would supply 11,554,400 tons, which would furnish 300 tons per day for 128 years. The annual consumption of coal at Rio de Janeiro is estimated at 240,000 tons, at Monte Video, 180,000 tons, and at Buenos Ayres 150,000 tons. Mr. Gilroy calculates that the new mines could raise the coal at a cost of 4s. per ton.

THE French Government laid before the Chamber on Saturday, April 3d, the Paris Metropolitan Railway Bill, and the provisional agreement entered into between the Minister of Public Works and M. Albert Christophle, the Governor of the Credit Foncier. The capital of the company will be 50,000,000 fr. It is estimated that the works constructed, the cost of property acquired, interest and, in short, the total expense will amount to from 450,000,000 fr. to 475,000,000 fr. Of this total the first series of works, that is to say, the construction of the underground artery, the circular line, and the union of the western and northern stations, will require 225,000,000 fr. The above ground artery alone will absorb the rest, the appropriation of property in the heart of Paris making the establishment of this central line very costly. The State gives a guarantee of 4 per cent. on the total expense; but it believes that by an arrangement it has made, it has considerably diminished the burden of this guarantee.

RAILWAY construction (in the U. S.) so far this year is 30 per cent. greater than at the same time last year; the probabilities are, however, that between 7,000 and 8,000 miles of road will be built during the year; the capacity of the mills is 10,000, but in addition to the 7,000 or 8,000 miles there will be large contracts for sidings. The rail mills of the country will be taxed to their utmost capacity. At this time there are inquiries in the market for some 50,000 tons, to say nothing of a score or more of enterprises which are expected to reach the market next month or month after; prices are likely to advance, and rails are quoted to-day at $35 to $36. Considerable material has been cabled for by brokers acting for buyers, especially from consumers of steel. There is an active demand for steel and iron wire rods, and for tin plates. The large production of copper is promised, and prices will rule low. The iron and steel industries are in good shape, and prices are likely to advance.—American Correspondence of "Herapath's Railway Journal."

THE United States Minister at Bogota, U.S. of Colombia, has been in Pittsburg in the interest of M. Cisneros, who is building a number of railroads in that country. He said: "The great need of the country is railroads, as the mines and most productive regions are in the interior, and as the roads are poor, it costs about 4 cents per pound to get the freight to Bogota. From the mouth of the Magdalene river to the rapids, a distance of 600 miles, steel boats are run. A railroad runs around the rapids, after which, by 40 miles on mule back and 30 miles in carriage, Bogota is reached. The reason why we have not more trade with your country is that Spanish, French, English and German steamships come regularly to our ports, while all trade with the United States must be carried on through foreign lines. A blast furnace and a rolling mill has been built at Bogota recently, and it cost more to get the machinery from the steamers to its position than the purchase money and freight from Wilmington, Del., where it was made, to the Magdalene river. The recent revolution has nearly stopped all business, but it will pick up again soon."